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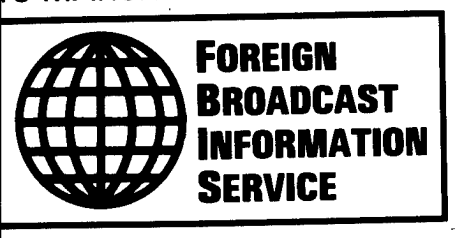


# JPRS Report

# Science & Technology

## Europe & Latin America

ERRATUM: This report republished to provide correct cover.

# Science & Technology
## Europe & Latin America

*JPRS-ELS-88-009* *18 MARCH 1988*

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## TECHNOLOGY TRANSFER

# ADVANCED MATERIALS

## French Analysis of Magnetic Liquid R&D

*3698A091 Paris OBSERVATOIRE DES TECHNOLOGIES STRATEGIQUES in French Nov 87 pp 2-5*

[Article by Ph. Zenatti in cooperation with Mr Bacri, Mrs Perzynski, and Professors Salin and Massart of Pierre and Marie Curie University, Paris: "Magnetic Liquids or Ferrofluids"; all quotation marks as provided by source]

[Text] Subject: Magnetic liquids are magnetized in the same way as metals, keeping their liquid properties. These products are starting to come out of university labs and beginning to be used industrially. There are applications for them in all fields. Their market is just opening up, but it is extremely promising.

### 1. Magnetic Liquids

Magnetic liquids are magnetized like ordinary iron bars when there is an outside magnetic field, but they also act like fluids capable of matching the form of their container, flowing, and bypassing obstacles.

These liquids contain small particles (on the order of 10 nanometers) of a magnetic material in suspension. These particles act exactly like the molecules of the liquid carrying them.

Due to the small size of the particles, the Brownian movement is able to keep them in suspension (a so-called "colloidal" suspension). However, this movement does not prevent them from attracting one another, which results in rapid clustering and sedimentation of the particles.

Two techniques are used to prevent this phenomenon.

The first consists of covering each particle with an elastic coat of molecules (surfacted ferrofluids [?ferrofluides surfactes]).

The second involves charging each particle electrically in order to introduce an electrostatic repulsion between them (ionic ferrofluids).

The ionic ferrofluids technique was developed by Prof Rene Massart (Pierre and Marie Curie University, place Jussieu, Paris, phone: 43.36.25.25, ext. 3166). It is less cumbersome, faster, and much more flexible than the surfaction method generally used in the United States.

"Durability" of ferrofluids is excellent (at least 7 years) if they are contained in closed systems, which are either flexible or rigid.

Finally, it should be noted that the magnetic particles may also be drowned in polymers, elastomers, and many composite materials.

An introductory film (16 mm, 25 min) is available from the CNRS [National Center for Scientific Research] audiovisual department (phone: 46.72.49.51).

### 2. Applications

The major interest in ferrofluids is based on the combination of liquid and magnetic properties.

This characteristic gives them an ever-growing list of many possible applications.

In medicine, a ferrofluid with the same salinity and acidity as blood serum was synthetized in 1986; since then, due to magnetic guidance, it has been possible to transport medications to a specific point. Ferrofluids can also be used in medical imaging as well as in the treatment of cancer because it has been noted that the sick cells capture iron particles which can destroy these cells by local heating under the effect of X-rays.

The optical properties of ferrofluids make it possible to develop light modulators (with a response time of microseconds) and detect magnetic fields. In this latter area, they are the sole means for detecting malfunctions in magnetic tracks with micron-level accuracy.

Ferrofluids are also used in many other fields, such as loudspeaker coils, vibration absorbers, inks for electronic printers, magnetically maintained seals, etc.

The following applications are also being studied or developed: accelerometers which permit controlled movement of manipulator arms; high-yield, low-frequency acoustic sensors; precious-metal sorters operating on the difference in apparent density; jacks for extremely delicate positioning. Also, the capability of ferrofluids to change their shape makes it possible to create "artificial muscles" in mechanical devices, etc.

Servo-assisted shock absorbers which adjust themselves to the terrain can also be designed because the viscosity of a concentrated ferrofluid depends to a great extent on the intensity of the magnetic field to which it is subjected.

Finally, this list—which is far from complete—should include other possible applications which are less strictly technical, but undoubtedly extremely profitable: Given the behavior of a ferrofluid which is subjected to a magnetic field and its rapid, surprising, and often very esthetic shape changes, it is obvious that it will definitely be used in costume jewelry and toys in the very near future.

In terms of products, these last two fields are wide open and without competition. There is undoubtedly an outstanding opportunity for a company interested in taking advantage of this.

### 3. Companies and Research Centers Involved

While various laboratories can be cited in France and abroad, the competitive situations are difficult to define because research is still primarily conducted on a theoretical level, although a few industrial companies have already brought out several products.

The "discovery" of magnetic liquids was made by an American, Ronald Rosensweig, in the 1960's under commission from NASA for Explorer 13. This scientist founded Ferrofluidics Corporation, a company which is the world leader in the field and which offers not only magnetic liquids, but also mechanical devices in which these liquids can be used.

In the United States, research is conducted mainly by Colorado State University at Fort Collins and the Massachusetts Institute of Technology (M. Zahn and R. Shumovich).

In Great Britain, the University College of North Wales in Bangor (Wales) is also working in this field.

The Soviets show their interest in ferrofluids through research conducted by M. Zaitsev and M. Shliomis of the University of Perm, as well as by A. Gailitis of the University of Riga. (It should be noted that the next world congress on this subject will be held in Riga in 1989.)

Japanese scientists take a much more technological approach than most of their colleagues.

Matsushita Electric in Osaka has developed a prototype printer which uses ferrofluids instead of ink. Hitachi protects the hard disks of auxiliary memories by magnetic-liquid joints; Diesel Kiki in Tokyo brought out an inclinometer which is accurate to 0.2 degree. Generally speaking, small- and medium-sized Japanese companies seem to be interested in this field. About 60 of them, including Taiho Industries Co. Ltd. and Matsumoto Ltd., have developed prototypes or are beginning to bring out products.

France is also involved in the scientific and industrial competition.

At the Pierre and Marie Curie University, a team of basic researchers—Jean-Claude Bacri, Regine Perzynski, Dominique Salin (phone: 43.36.25.25, ext 45.28)—are working in close cooperation with Rene Massart, the moving force at the laboratory of physics and inorganic chemistry (phone: 43.36.25.25, ext 31.66). This lab is oriented particularly toward the development of products and the study of their applications.

These scientists are willing to advise companies interested in ferrofluids as soon as the companies have a definite and defined study project.

Two more research centers are interested in magnetic liquids: the University of Nancy, which takes a more theoretical approach (M. Brancher, phone: 83.32.39.01), and ESPCI (Graduate School of Physics and Chemistry of Paris, Mr Wesfreid and Mr Allais, phone: 43.37.77.00, ext 322), which takes a more general view oriented toward the study of the behavior of liquid metals (in fusion or mercury-type metals) subjected to electric fields (in cooperation with Supelec [Graduate School for Electricity]).

The only French company to develop, manufacture, and distribute ferrofluids is Union Chimique Europenne (UCE, Saint-Fromont, 50620 Saint-Jean de Daye, Mr Mercuriot, phone: 33.55.40.79). 4. Stakes

The economic stakes in ferrofluids cannot be expressed in meaningful figures at this time, but they are bound to become extremely important.

In fact, the list of these products continues to grow, especially due to the French development process which makes it possible to create specific ferrofluids (adapted particularly to corrosive or physiological environments) and to control their characteristics (ANVAR [National Agency for the Implementation of Research]/CNRS 1980 patent, licensee: UCE). Add to this the fact that other technologies offering possible and useful applications are reaching a point of "maturity" (medical imaging, robotics, etc.).

They constitute a technological and industrial opportunity in a field in which no country currently has a really decisive lead.

25053

## France's Saint Gobain Expands Ceramics Activities

*3698a113 Paris L'USINE NOUVELLE in French 3 Dec 87 p 51*

[Article by Gerard Larpent: "Technical Ceramics: Saint Gobain Aims at European Leadership"; first paragraph is L'USINE NOUVELLE introduction]

[Text] The keynote: to improve productivity in traditional refractory materials and to buy back companies for developing new technologies.

Saint Gobain is going shopping: After buying back the German Stettner and the American Corhart, the group's "industrial ceramics" branch will continue to acquire companies, especially in Europe and the United States. Zirconia and composite materials will be the first product goals.

The drop of the dollar combined with the progression of the group's results will encourage this trend; this is especially true for branches linked to growing markets such as reinforcement fibers and industrial ceramics. The task of Emile Francois, manager of these two branches, will be facilitated by the reorganization that he is setting up.

Consisting of numerous companies—some of which were sold and then bought back in the early 1980s—this department will henceforth be divided into three divisions: electrically melted glassworks (Fr 1.25 billion in turnover, 1,800 employees), silica (Fr 250 million, 600 employees), and technical ceramics (Fr 1.05 billion, 2,600 employees). Emile Francois' creed—shared by other managers of the group—has the advantage of being simple: improve productivity of basic skills and expand related but very promising activities. Thus, thanks to the improvement in productivity, the department of electrically melted refractory products intended for the glass industry is recording a strong profit earning capacity although its market is stagnating, even slightly declining in Europe. The markets for silica products (optical fibers, thermal shield wires, etc.) and technical ceramics, however, are in full development. In these markets Saint Gobain is already one of the leading European manufacturers of special refractory materials or composite reinforcement fibers. "But our ambition is to go even further," confesses Francois Wanecq, who is in charge of this division. That means being the leader. Hence the recent takeovers and clearly displayed ambitions.

But why buying instead of developing its own products and processes? Francois Wanecq's response: "It is not possible to improvise expertise in these skills: Even if they are closely related, they are not ours." Supported by its financial resources and its commercial networks, the group will look for technological skills in the companies it is taking over. "Many of our competitors have developed major research labs," Francois Wanecq continues. "Yet, their industrial activities do not include technical ceramics. They are always after future products."

Saint Gobain's approach, which is much more pragmatic, consists of the daily application of methods and products that will become tomorrow's technologies. This recently happened with the renovation of the blast furnace No 4 of Usinor, Dunkerque, for which Saint Gobain's Savoie Refractaire subsidiary got hold of a Fr-45 million contract for the supply of high-performance refractory materials based on chromium oxyde and silicon carbide.

Alas, this type of contract is rare. In spite of promising negotiations with the FRG, Sweden, and even the PRC, the Savoie Refractaire company is aiming at other markets, such as garbage incineration or the carbochemical or petrochemical sectors.

Another subsidiary (Kerlane), which manufactures ceramic fibers based on alumina-silica or zirconia-alumina-silicon, has a similar approach. Without underestimating the stakes of ceramic engines, the company is moving gradually by first offering its products as materials for aluminum matrix reinforcment. This allows an internal-combustion engine piston to function at a temperature of 350 degrees centigrade instead of 250.

Today with new research teams and the acquisition of Stettner and Corhart, the "special ceramics" division is sure to find new markets soon. In these times of monetary uncertainty, it is also fortunate for having secured a foothold on both sides of the Atlantic in order to protect itself against dollar fluctuations....

25048

## Netherlands Opens Advanced Ceramics R&D Center

*3698A103 Zoetermeer SCIENCE POLICY IN THE NETHERLANDS in English Sep 87 p 17*

[Unsigned article: "National Ceramics Studio Set Up"]

[Excerpt] "We can safely say that the National Ceramics Studio is an enrichment of the research infrastructure in technical ceramics in the Netherlands," said Dr R.W. de Korte, the Minister for Economic Affairs, when he opened the Studio at the Netherlands Energy Research Foundation (ECN) in Petten last June.

Research and development in technical ceramics are making steady progress, said Dr De Korte, and that will help the Netherlands' future competitiveness. "One may think of work in ceramic coatings, fuel cells and applications in the process industry," he said. The studio was equipped with the help of a 5.2 million guilders grant from the Ministry of Education and Science as part of the spearhead programme for materials research. The Ministry will provide 1.2 million guilders a year until 1990 for the studio's running costs provided the ECN gives the same amount. A four-year programme for technical ceramics has been set up as part of the Innovation Research Programme, which comes under the Ministry of Economic Affairs. Thirty million guilders have been earmarked for this on condition that other partners (research establishments, industry) provide the same amount.

The studio's job is to find optimal compositions of materials in powder form for the manufacture of high quality ceramic products as well as to develop pieces as semifinished products and prototypes for other research establishments and industry. The work will be done in cooperation with the Universities of Twente and Eindhoven, the TNO Institute of Applied Physics and others.

# AEROSPACE, CIVIL AVIATION

## MBB-Aerospatiale Space Agreement

*3698a134 Paris L'USINE NOUVELLE in French 24 Dec 87 p 39*

[Text] The two European groups are again reinforcing their links. MBB and Aerospatiale have concluded an alliance in the space technologies field. The program includes: the hypersonic airplane for space transport, orbital stations, and satellites, as well as new materials which will replace current composite materials.

25063

## Aerospatiale of France Expands Production Capabilities

### Saint-Nazaire Automation

*36980149a Paris LE FIGARO in French 22 Jan 88 p 19*

[Article by Pierre Kerlouegan: "Aerospatiale: Automation to the Rescue"; first sentence LE FIGARO introduction]

[Text] A new, entirely automated riveting workshop is making it possible to assemble an Airbus section more quickly and with less manpower than before.

The difference in output between an entirely automated riveting machine and a well-trained worker using traditional works equipment is six rivets to one. In only seven seconds, the machines bores, mills, applies a sealer, and selects, positions and jolts a rivet. It does all this with a precision of less than one-tenth of a millimeter.

These results have recently been achieved by Aerospatiale in its Saint-Nazaire factory, where an Airbus 320 fuselage section, that is, an aluminum tube 6 meters long and 3.95 meters in diameter, is assembled. Unique in Europe, and in the world, this workshop is a precursor of the factory of tomorrow, where robots will replace workers.

Even before the dollar's drop, which makes the need to reduce production costs even more imperative, no export-based business would have rejected a program designed for this purpose. Aerospatiale's "airplanes" division—which sells 70 percent of its production to foreigners—has set its goal at reducing internal costs by 30 percent in 3 years.

The first avenue for achieving this is to promote the use of sub-contracting, that is, to have others do small jobs that Aerospatiale does not know how to do at low cost—without sacrificing quality. The volume of sub-contracting is 20 percent today: it will climb to 37 percent within 3 years.

#### Stable Staffing Levels

The second avenue is to increase internal efficiency. "Of course, this entails heavy investment," acknowledges Jean-Paul Chandez, assistant director of Aerospatiale's "airplanes" division, "nearly 1,300 million francs in 1988." And the introduction of automation in a workshop requires training workers for the new tasks. This year, a sum nearly equal to 4 percent of total salary expenditures will be allocated to the training of personnel, which includes fewer and fewer laborers and an increasing number of technicians.

The new riveting workshop that has just commenced operations cost 14 million French francs. According to Jean-Marie Mir, director of the Saint-Nazaire factory, the profitability of the investment will be assured in 3 years. It took 858 hours to assemble the Airbus 320 section, which contains 16,000 rivets, using manual riveting procedures, and 430 hours using semi-automatic procedures. With the new, entirely automated process, it takes only 120 hours, or a gain of 86 percent.

And, if the advantages afforded by the use of a computer-controlled loading bridge, for example, are figured in, a 13 to 1 savings in manpower is obtained compared to manual procedures.

This does not, however, mean that the Saint-Nazaire factory is going to lay off staff. In fact, the rate of production of the Airbus 320 will need to increase rapidly, climbing from 2.2 units a month from the Toulouse factory today, to 8 by the end of 1991. With current staffing levels—2,200 people—held constant, then, Saint-Nazaire will produce more: 60 airplane sections last year, 86 projected for this year, or a gain of 43 percent.

And this gain will be increased still further with the installation of a second automated riveter. When the first Airbus 340s roll off the assembly lines in 1992, the time needed to manufacture one kilo of airplane will have been cut in half compared to what it was 20 years ago, when the first airplanes of the European consortium left the factory.

### New Toulouse Factory

*36980149a Paris AFP SCIENCES in French 23 Dec 87 pp 17-18*

[Text] Toulouse—Aerospatiale's new Toulouse factory, which will manufacture the future Airbus 330-340s, will be operational at the end of 1989, announced Mr Jean-Louis Fache, assistant director of the Airplanes Division, 21 December in Toulouse.

This installation was made necessary by the size of the A-340 (63 meters long, a 60 meter wing span, 17 meters high), which made it impossible to assemble it in the three existing structures on the St-Martin-du-Touch site, where the Airbus and ATR (regional transport plane)

lines are currently built. Located in the township of Colomiers (Haute-Garonne), in unincorporated Garonne, the unit will include all the necessary infrastructures spread over a terrain of 50 hectares.

"Aerospatiale-Toulouse must be prepared to progress from an annual production, including all types of airplanes, of 60 planes in 1986, to 160 in 1990 and nearly 250 in 1995," declared Mr Fache.

To meet this challenge, Aerospatiale's Airplanes Division has decided to found its strategy on site specialization, strategic and operational coherence, increased productivity and adaptation of the human organization to the new concerns. "Some 17 billion French francs will be invested, 10 billion for development and 1.5 billion in Toulouse," Mr Fache said.

With this in mind, assembly design was completely rethought. To avoid the drawbacks of linear assembly lines in which planes advance pushing ahead the preceding one, making stations dependent on one another, the new factory will be equipped with a modular production line, the first in the world.

"This allows each team to manufacture 'its' plane almost in entirety. It represents an overall time gain [worth] around 100 million French francs over 10 years," affirms Mr Louis Castanie, head of the trial assembly line design group.

Mr Fache also noted that the first two A320s would be delivered next March and April, to Air France and British Caledonian respectively, that the 100th ATR42 would roll off the Toulouse assembly lines in May, and that the first flight of the ATR-72 would take place in the fall of 1988.

By the end of December, 35 customers had placed firm or tentative orders for 245 ATR42/72s, of which 70 "42s" have already been delivered. Moreover, Airbus-Industrie has taken 467 firm orders for A300s and A310s, 294 orders plus 167 tentative orders for A320s, and 80 [orders for] A330s and A340s, in addition to 29 tentative orders for the A330 and 35 for the A340.

9825

## Netherlands Space Research Projects Overviewed

*3698A102 Zoetermeer SCIENCE POLICY IN THE NETHERLANDS in English Sep 87 pp 14-16*

[Article by Guus Termeer and Stan Termeer: "Don't Give Up When the Harvest Is Ripe—Space Research Agency's Director Concerned About National Programmes"]

[Excerpts] Man has an age-old fascination with space. Since Galileo Galilei turned the first telescope towards the heavens in the early 17th century, literally astronomical sums have been spent to improve techniques. Today there are telescopes with a diameter of some six metres, hundreds of satellites to study both the earth and space, space vehicles and space laboratories. The most recent developments have included the use of space for scientific research, the creation of permanent and temporary space platforms and the industrial use of space.

Spending on space research in the Netherlands will have risen from 115 million guilders in 1985 to 187 million in 1990, keeping the Netherlands in step with the other members of the European Space Agency (ESA). Just under sixty percent of this amount comes from the Ministry of Economic Affairs; the Ministry of Education and Science meets 35 percent and the rest is the responsibility of the Ministries of Transport and Public Works, Defence, and Welfare, Health and Cultural Affairs. A seventy-percent increase in the overall budget, agreed in Rome in 1985, is intended to strengthen Europe's independence in space travel.

### Micro-Gravity

The SRON [Netherlands Space Research Agency] held a symposium in Utrecht last April on micro-gravity, a fairly new area of space research. "New space sciences", a term which includes micro-gravity experiments, differs from astronomy or remote sensing in that it covers research in space itself, for example into materials, physics, chemistry or the life-sciences. The latest Spacelab flight, the D-1 mission organised by West Germany, consisted of eighty experiments, including nine from the Netherlands, carried out by Wubbo Ockels, one of the speakers at the symposium, and his colleagues. People in the field have stated that the high quality of the Dutch research proposals ensured that a relatively large number were included. Dr Pieter van Nes, SRON's micro-gravity research coordinator, points out that such research is still in its infancy. "The time available for experiments is still very small. One ESA Spacelab mission and the German mission, of which the ESA had less than half. A total of some fifteen days experiments. The Germans are the largest investors in this sort of research in Europe and they have dozens of research teams, compared with ten to fifteen in the Netherlands. So the main aim of a symposium like that in April is to make contacts with leading scientists and to arouse interest."

The result of the various experiments ("amazing", said Dr Van Nes) were discussed. For example, test-tube experiments showed that white blood cells behave quite differently in a state of near weightlessness. They no longer carry out their function of eliminating harmful substances. It is not yet known whether the human body is able to get them to resume this work somehow or whether the body's defences are indeed affected. Other experiments showed that bacteria reproduce more rapidly in the absence of gravity and that they are more resistant to antibiotics. Anyone who develops an infection in space will therefore run a greater risk than on

earth. These and other experiments (such as the one which showed that male fruit flies did not live as long in zero gravity) convinced the symposium that life on earth is affected by gravity.

### Materials

The space missions included experiments in materials science as well as those in biology and medicine (the latter consisting largely of an investigation of the human balance mechanism). One example was the production of pure crystals in space. It was shown that pure mercury iodide crystals were well suited to the detection of gamma radiation. The earth's gravity makes the production of such crystals impossible as it causes deformations. An experiment with protein crystals showed that they could be grown a thousand times bigger than on earth, making it possible to determine the three-dimensional structure of protein. It would also make it possible to produce artificially certain proteins that were otherwise difficult to obtain. The Dutch experiments in materials science and physics came from Groningen University (formation of liquids), the National Aerospace Laboratory (NLR) (behaviour of liquids in zero gravity) and Delft University (controlled solidification of cast iron). Dr Van Nes commented that interest in materials research in space seemed to be more firmly established in other countries than in the Netherlands, where there was much more interest in medical and biological experiments.

### SRON

The micro-gravity experiments are a fairly new area for SRON [Dutch Space Research Foundation]. The agency, which coordinates all Dutch space research, is part of the Organisation for Pure Scientific Research (ZWO) and as such comes under the Ministry of Education and Science. It manages the funds made available by ZWO for space research and maintains the National Institute for Scientific Space Research, which consists of three laboratories in Leiden, Utrecht and Groningen. Their staff of 150 are mainly working on technical and scientific research, such as the development of measuring equipment for astronomical and astrophysical research. The results are then made available to scientists who come to the agency for technical assistance. SRON's director, Prof. J.A.M. Bleeker, says that the Netherlands has a good reputation in the field of high-energy astrophysics. The IRAS [Infrared Astronomical Satellite] gave it a start in infrared research and the ANS [Astronomical Netherlands Satellite] project was very useful for X-ray research. The Netherlands is also among the leaders when it comes to research concerned with the earth, for example the observation of changes in the earth's crust which can help predict earthquakes. There is also the micro- gravity research, which could become another strong point in the national space research programme. Prof. Bleeker himself has had a distinguished career: extraordinary professor of Space Research at Utrecht University, director of the Space Research Laboratory in Utrecht and director of SRON. He has also been a member of numerous international research committees and chairman of the advisory body that drew up "Space Science Horizon 2000", a long-term research plan for ESA.

## SNECMA's Flexible Production Achievements Explained

*3698a122 Paris L'USINE NOUVELLE in French 10 Dec 87 p 60*

[Article by Michel Defaux: "SNECMA Goes For Flexibility"; first paragraph is L'USINE NOUVELLE introduction]

[Text] In Le Creusot on Tuesday the president opened the most advanced flexible workshop in France. Its first financial results are expected in early 1989.

SNECMA's [National Company for Aircraft Engine Studies and Construction] flexible workshop in Le Creusot, which will not be fully operational until late next year, has just delivered its first component: a turbine disk for the CFM-56 jet engine. After RVI's [Renault Industrial Vehicles] plant in Boutheon and Citroen's in Meudon, this is the third large flexible workshop to be set up in France.

It is certainly the most advanced manufacturing facility to date. There is, however, an essential difference, as explained by Claude Chabanas, its director, at the latest SITEF [International Fair of Future Technologies and Energy Sources] technical seminar: "It is not a laboratory, but a production factory. We expect it to have an innovative and motivating effect on the whole group."

Just one equivalent workshop exists outside France: the Rolls Royce flexible workshop in Derby (Great Britain), which manufactures practically identical parts. However, while the British management has opted for a modular approach, in Le Creusot SNECMA has been thinking big...from the beginning. The brand-new factory (an investment of Fr 345 million, 50 percent being defrayed by the government), which includes the flexible machining workshop and also numerous cells, carries out all necessary operations on the parts.

To minimize technical risks, its development was particularly meticulous: Detailed preliminary research and economic feasibility studies succeeded one another between 1981 and 1985. "Rarely has research been taken so far," emphasizes Guy Doumeingts, assistant director at the Grai laboratory of Bordeaux 1 University, which took part in the integration of the production control process with the other functions. Also the follow-up on the project was exemplary. A small team of five people is responsible for research, investment, and resource allocation; it will also be in charge of the start-up until the normal rate of production is reached. "If we encounter problems, it will be easy to identify those responsible," is the observation at SNECMA.

On the technical level priority was given to research. It was considered preferable to integrate various existing components rather than to aim for innovation in terms of equipment. This approach resulted in a system for production sequence control (monitoring systems, automated warehouse, wire-guided vehicles), the elimination of preparation times (masked-time work) and part-by-part machining rather than in batches.

In the workshop the whole production process is organized around the central warehouse and the area where parts are prepared on pallets, which are then carried automatically by wire-guided vehicles to the 10 vertical boring and turning mills, the four jig borers, and the two part-washing machines.

An original feature is the transportation of cutting tools using an overhead handling system. "In our production process machining time amounts to 2 hours per operation, while the lifespan of tools used on components in Inconel 718 does not exceed 10 to 20 minutes. We therefore need to cope with a considerable flow of tools and a limited flow of components." The processed components are taken away by a second network of wire-guided vehicles which serve the neighboring specialized cells (broaching, milling, non-destructive control, etc.).

As a general rule, the operator starts up an operation on an automated machine and carries out other work during the time taken. "In this way the broaching cell, with three machines and two numerically-controlled grinders, is operated by three persons and soon, maybe, two."

The first aim of the new plant at Le Creusot is to reduce manufacturing cycles. These will go down from 5 and 1/2 months to 1 month, while production costs will be reduced by several dozen percent. Those in charge do not want to be more specific. This is a wise precaution in view of previous experience; the economic results of some of the large flexible workshops tend to encourage caution. It will be necessary to wait for the beginning of 1989 to put forward indisputable figures and make an assessment.

25065

## AUTOMOTIVE INDUSTRY

### Netherlands Prepares Digital Road Map for Smart Car Project

*3698A068 Amsterdam COMPUTABLE in Dutch 30 Oct 87 pp 25, 29*

[Article by Yvonne van de Meent: "Database for 'Carin' Car Navigation System: Tele Atlas Is Putting All of Holland in the Computer"; first paragraph is COMPUTABLE introduction]

[Text] Tele Atlas, an electronic publisher in 's-Hertogenbosch, is preparing a digital road map of the Netherlands. All highways, roads, and squares will be stored in a detailed database which Philips needs for its Carin car navigation system. The Tele Atlas video car will soon make its appearance in Dutch towns and villages to record even all house numbers. According to Tele Atlas Manager O. Van Schelven, building the database is "an enormous task" which is being dealt with incessantly by the 70 employees of the young and rapidly expanding company.

"It is drudgery we simply have to plunge into," says O. Van Schelven, commercial manager of Tele Atlas, the electronic publisher. The company is currently building a database which includes all roads, streets, and even house numbers in the Netherlands. Tele Atlas collaborators are making a stylized map of the Netherlands' road network using CAD equipment. Employees work in shifts; the computers are down only 2 hours out of 24.

Tele Atlas is making the database primarily for Philips, which needs a detailed electronic road map for its Carin car navigation system still under development. Philips' intention is to equip every car with an on-board computer in the future. This computer will help the driver plan the trajectory. After entering both the departure and destination locations, the driver will constantly receive information about the road to follow, either spoken or via a map display on the monitor. It will still take a few years before the necessary Philips equipment is marketed. In the meantime, Tele Atlas is working on the database.

"A few years ago Philips asked us if we would be able to build the database," explains Van Schelven. "At that moment, Tele Atlas was a small shop ready to expand. So as an experiment we made a line segment base of the city of Eindhoven."

After the test project, Philips asked Tele Atlas if it wanted to make a database of all the Netherlands roads and streets: a gigantic project. A calculation of the costs soon revealed that building such a database for Philips alone was not profitable and Tele Atlas started looking for other applications and other customers. It appeared from a market study that there were about 300 potential customers for a line segment base, including transport companies, provincial governments, the Defense Department, or the road accident registration office. With the help of specialist software, all kinds of logistic and urban and rural planning problems can be solved with the database. It is also a good basis for making electronic maps and displaying traffic situations.

#### Matrix of Distances

Tele Atlas already had a basis for building the database: the "routes and distances" database developed for the transportation industry. Philips' car navigation system, however, requires a far more detailed database. "Routes and distances" links about 6,000 places in the Netherlands, but the new database has to link all addresses in the Netherlands.

Collecting all the data for such a vast database is "an enormous job," says Van Schelven. Much of the data has already been recorded in various government archives and, for example, in the postal code database of the PTT [Post, Telephone, and Telegraph]. Tele Atlas receives information from hundreds of sources. "It is a very diverse lot," explains the manager, "municipalities, provinces, and polder districts. Also, the quality of the data supplied differs enormously. One source supplies the data neatly on a diskette, but others supply data on the back of cigar boxes." When data is missing, Tele Atlas does its own field research. Collaborators regularly go out to survey crossroads or make drafts of new traffic situations. So it is real manual labor.

**House Numbers**

Before long Tele Atlas will be collecting part of this data electronically because the video car should be operational in January. "Just imagine a little van completely packed with electronics," explains Van Schelven. "Two video cameras are placed in the front and cameras are fixed to the left and the right sides of the car. Besides, via a reversed car navigation technique data is collected, sent directly to a computer, and digitized. The computer automatically verifies old data, thus constantly updating the on-board electronic map. So, the video car will collect new data and will make us less dependent on data suppliers."

The video cameras are of a special type: Images taken from a moving car are usually blurred. This is not true with these cameras. "Even at a speed of 70 kilometers an hour the separate house numbers can still be read on the tape," Van Schelven states, not without pride. These house numbers are essential to the database: To make a reliable electronic city map, it is necessary to know the house numbers on the corners of the streets.

The house numbers have to be read from the videotape by Tele Atlas staff, which is a very time-consuming business. "The next step, of course, is the automatic scanning of the videotapes, but that is beyond our capabilities for the time being," says Van Schelven. "In the Netherlands, house numbers exist in all varieties, from red ceramics to black with blue digits. A computer cannot yet be programmed to recognize all of this as house numbers." The video car will record all streets in the Netherlands and will return to the same street every 3 years on average. Tele Atlas hopes to finish the car navigation database by 1993. The videotapes are stored. Together they constitute the optical database of Tele Atlas.

25012

## BIOTECHNOLOGY

### New Biotech Center in FRG

*3698a121 Paris L'USINE NOUVELLE in French 17 Dec 87 p 178*

[Text] Next year the technological university at Braunschweig should become a partner of the Biotechnological Research Company. The federal state has decided to create a national center for microbiology research there and will finance its construction with Fr 185 million.

25063

### French Analysis of Biosensor R&D

*3698A087 Paris OBSERVATOIRE DES TECHNOLOGIES STRATEGIQUES in French Aug 87 pp 1-6*

[Report by Philippe Zenatti with the assistance of Sylvia Vaisman of BIOFUTUR: "Biosensors"]

[Excerpts] Subject: Biosensors are devices which, by associating a biochemical compound with an electrode, allow the detection and measurement of chemical or biological substances. Applications are mainly found in the chemical and agro-food sectors, in medicine, and environmental control. This awakening market is difficult to delineate; however, the development of this technology opens broad horizons.

**1. Biosensors**

The concept of biosensors is still rather recent, since it goes back only 15 years or so. It entails associating a biochemically active compound (enzyme, antibody, living cell, etc.) capable of recognizing a given substance with an electronic system able to convert the activity of the compound into an electrical signal.

They are mainly used for the detection of chemical or biological substances and for analysis (they are likely to replace, for instance, spectrophotometers, fluorometers, gaseous phase chromatographs, mass spectrometers, etc.).

The life of sensitive compounds is about 1 week; after that the electrode, on which the enzyme, the antibody, or the living cell is fixed, must be reimpregnated; this is done rather easily by dipping the electrode into a gel, or by spraying it with an aerosol.

The accuracy of biosensor analysis is comparable or superior to that obtained by conventional means. Biosensor analysis is often more rapid, especially for the measurement of lactic acid, urea, glucose, and potassium. Thus far, however, it has not seemed suitable for heavy work loads involving several hundred analyses per hour.

**2. Industrial Applications**

There are three primary sectors for biosensors—the medical, industrial, and environmental control sectors.

To date, several companies—mainly Japanese—have marketed biosensors to measure levels of glucose, lipids, cholesterol, urea, lactic acid, potassium, albumin, and certain pathogenic bacteria.

The agro-food sector uses biosensors for the evaluation of the freshness of fish by measuring the three elements produced during decomposition of the fish flesh (inosinic acid, inosine, and hypoxauthine). The degree of palatability of food is evaluated by measuring the glutamic and nucleic acids; cheese production is controlled by measuring the decomposition of the casein. There are also biosensors for the quality control of fats and oils and for the production of alcohol.

Environmental control uses biosensor analysis to accurately measure the percentage of oxygen dissolved in water.

**3. Companies and Research Centers Involved**

The biosensor sector is substantially dominated by Japanese laboratories and companies.

Prof Isao Karube of the Tokyo Institute of Technology initiated the studies on biosensors. Back in 1974, he produced a prototype that detected hydrogen peroxide in foods. Professor Aisawa of the University of Tsukuba has developed an energy transduction system for oxidoreductases. Other Japanese researchers can also be cited, among them Dr Inakuchi of the Okazaki Institute of Molecular Biology for his biological electrophilic compounds.

Glucose and lactate biosensors have been developed in the United States by Yellow Springs Instrument, Universal Sensor Inc., and Provesta Corporation (a Philips subsidiary).

Prototypes are being developed in Great Britain (Thorn Emi and Granfield Institute), the Soviet Union (Academy of Sciences), Hungary (Radelkis), and the GDR.

France is not inactive, and among those working in this field we can name:

— Prof D. Thomas (Compiegne University) who developed the multiparametric enzymat with interchangeable membrane marketed by the Seres Company. This biosensor makes it possible to measure, in 1 minute and with high reliability, concentrations of about 10 different substances found in contaminated mediums, including inosine, glucose, amino acids, alcohol, etc. — Prof P. Coulet (Paul Sabatier University in Toulouse) who developed a digital-display glucoprocessor (marketed by Tacussel in Villeurbanne), as well as the lactate AL-7 biosensor (marketed by SGI Setric).

Among the French firms developing biosensors are the Merieux Institute, Roussel Uclaf, Orsan, and Virbac.

**4. The Stakes**

Biosensors have a difficult market to pin down but a market that would be substantial if biosensors managed to compete seriously with conventional methods for detection and measurement of chemical and biological substances. These methods, however, are well-tested, low in cost, and also capable of being improved upon.

The character of the biosensor market has not yet been defined in great detail because of the hybrid nature of the products, associating as they do chemical or biological substances on the one hand and electronic equipment on the other.

Indeed, it seems that it is the new generation of biosensors that will create a specific market. Thus, Prof Isao Karube recently announced the development in his laboratory of a hormone and cancer cell immunosensor linked directly to a fluorescent microscope. In addition, an electronic chip has been developed that includes a large number of microsensors capable of distinguishing nearly 100 different substances that compose a taste or an odor.

To this imminent prospect of "sensor machines" must be added the longer-term prospect of the development of integrated circuits with components of organic molecules or of biological cells.

25050

## French Minister on FY 1988 Biotech Budget

*3698A076 Paris BIOFUTUR in French Oct 87 pp 6-7*

[Interview with Jacques Valade, minister delegate for research and higher education: "Toward an Implementation Policy for Research"; interviewer, date, and place not given; first paragraph is BIOFUTUR introduction]

[Text] Even if biotechnology will not solve every problem and even if some aspects of its development are still being questioned, for Jacques Valade, minister delegate for research and higher education, it is very much a field of the future generating new activities and leading to substantial improvements in any of its application fields. The Ministry of Research, already providing specific support, will maintain its efforts and even increase them in certain areas by favoring cooperation between industry and research centers. Jacques Valade, in his response to our questions, gives an indication of his attitude and thoughts.

The dialogue which follows is a nonexhaustive report of an open conversation which J. Valade, minister delegate for research and higher education, was kind enough to have with BIOFUTUR.

BIOFUTUR: Is the French community making enough effort in research and industrial development in the field of biotechnology, bearing in mind that some countries, particularly the United States and Japan, are involved in considerable endeavors?

J. Valade: Before responding to your question, I would like to make two comments. First, biotechnology is, I dare say, fashionable in France, too. When a region has problems with unemployment, its officials propose biotechnology and advanced materials as a possible solution; this has become something of an incantation.

Although biotechnology has long been under development in France—being from the Gironde region I cannot but mention the fermentation of grape juice, i.e., wine production—the industrial development of processes arising from the discoveries of modern biology is not always immediately profitable. Many companies that have joined in this adventure are still "in the red." In other words, biotechnology does not have the solutions to all our energy, agricultural production, and health problems, and nobody is pretending it does. For a country like ours to maintain its rank in the most basic biological research—a prerequisite to applied research—even if the resulting processes and products take a long time to evolve, it must not underestimate the short-term profits which can be produced by the impact of modern biology on traditional biotechnology techniques.

It should be understood that the state is heavily supporting the most ambitious research through its universities and major research bodies. Recent events have been marked, moreover, by great French discoveries for which we are envied; the identification of the AIDS virus is just one example. Yet we must not underestimate France's interest in applied research: for example the new technologies for the industrial exploitation of products from the earth. France is producing more and more corn; is this being adequately exploited? It is right that, because there is a shortage of starch plants, we have to import products based on our corn? We must intensify our efforts in this direction. I am convinced that, thanks to the great competence and realistic mind-set of researchers in this sector, particularly those of the INRA [National Institute for Agronomic Research], technology transfers will multiply; some very convincing examples of this were already presented at the BioExpo 87.

Now to your question: Is France doing enough in biotechnology? As a scientist I know all too well that the funds allocated to research are always insufficient. However, France is already doing a lot; tomorrow it will do even more. Let us quote some statistics: In 1987 the FRT (Footnote 1) (Research and Technology Fund) received Fr 750 million, a substantial share of which was invested in biotechnology and the agro-food sector. We are prepared to increase this aid.

BIOFUTUR: Mr Minister, it has been 9 years since the Gros, Jacob, and Royer report was drawn up at the request of President Giscard d'Estaing. Is it not time to evaluate French biological research?

J. Valade: The various bodies have their own evaluation procedures, but I am not against the idea of an inquiry to judge the level and the priorities of our R&D endeavors in biotechnology. However, I am sure that at this time, in addition to the need to strengthen basic research, it is necessary to stimulate industrial research and improve training facilities. The message to get across is that biotechnology is indeed a promising and future-oriented sector, even if there remains some uncertainty regarding the extent and timing of its practical spin-offs. Moreover, these uncertainties concern essentially high technologies—protein engineering, for example—rather than the less innovative technologies such as variety selection or maximum-use techniques such as methanation of residue. Methanation is not an exciting process, but it can considerably improve the balance sheet of an agricultural operation.

Recently the "Aliment 2000" program was initiated. It seeks to list all food resources and the transformation processes to adapt them to our constantly changing eating habits and our nutritional requirements. I think it would be a good idea to extend this program to the maximum use of products from the earth in all their forms. The 1988 FRT budget will be increased by 9 to 10 percent, which is considerable bearing in mind the funding involved. Our wish is to give priority support to those projects which are conducted by both university teams or researchers and an industrial partner, whose participation guarantees that the project will find practical applications.

BIOFUTUR: Does this mean that public support to biotechnology is going to increase by the percentage you mentioned?

J. Valade: The figure I mentioned refers to the total FRT budget and includes funding of civil research carried out for the military. Furthermore, the distribution of funding to the various organizations takes into account their transfer capacities and also, after evaluation, their health.

BIOFUTUR: Considering the imminent opening-up of the vast European market in 1992, is biotechnology considered a priority by European countries?

J. Valade: As minister of research, I take part in the work of the EEC Council of the Ministers of Research. Most of our European partners also have national research programs in biotechnology. I have noted that European officials are really aware of the importance of biotechnology for Europe. In the framework program for the coming 4 years, biotechnology has not been forgotten. In addition, biotechnology projects proposed within the scope of the EUREKA program will be discussed during the next meeting in Madrid. EUREKA is an excellent program and should be adaptable to biotechnology projects. It must be continued, even if the delay between the formulation of the project and its actual elaboration is inevitably long. On a European level, however, the priorities and the resulting programs are numerous: ESPRIT, RACE, and BRITE are examples. (Footnote 2) (ESPRIT: European Strategic Program for R&D in

Information Technology; RACE: Research and Development in Advanced Communications Technologies in Europe; BRITE: Basic Research in Industrial Technologies for Europe) Budget choices are therefore difficult. Short-term national interests do not always coincide and there is considerable temptation for a country to support a project from which it expects economic spin-offs. Any one of our partners could consider rightly that fishing techniques ought to be subsidized, even at the expense of molecular biology. But the ministers are nevertheless well aware of the fact that it is only by pulling together that the European countries will develop sufficient research power to take the place they deserve in the technologies of the future.

BIOFUTUR: What do you think about the big international projects proposed to the scientific community such as the Human Genome or Human Frontier?

J. Valade: Traditionally France participates in such projects. This was the case for research into new energies or astronomy. The Japanese Human Frontier program proposed at the Heads of State Summit in Venice was submitted to a college of experts. I cannot comment on this today. (Footnote 3) ( The minister of research is considering providing specific support to a program for in-depth study of the human genome. In what form, what amounts, and which beneficiary? To be seen...(Declaration of Dean Mornex, adviser to Jacques Valade))

BIOFUTUR: Is the French public's image of research satisfactory?

J. Valade: Scientists bother to inform each other of the development stage of their work. The major science magazines, reports from learned societies, and today, the databanks circulate scientific information. They are less concerned about informing the man in the street and if they do popularize, they frequently find it difficult to express themselves in terms their readers will understand. But indeed the man in the street, the citizen, has the right to be informed correctly and clearly of scientific progress. Of course, he is fascinated by science; scientific discoveries, technological mutations are a marvel to him...even if they are sometimes upsetting. But he does not have a clear awareness of the long road, marked by more failures than successes, which leads to discovery.

Overall, the image of science is positive; that of the researcher is ambiguous. What is the point of a researcher if he does not find what he is seeking? This could well be the question of the man in the street, sometimes even of elected representatives. We know that research is a collective undertaking. If the general public were better informed, they would realize that the rank and file researchers are also entitled to their share of glory and they would understand that the future of a country like ours is to a great extent dependent upon the input of its researchers, all its researchers....

The Ministry of Research has a role to play in making the general public aware. Biotechnology could constitute in this way a good opportunity to achieve this goal.

25041

## COMPUTERS

### Operations of ES2's New ASIC Plant Explained

*3698A072 Brussels ZERO UN INFORMATIQUE BELGIUM in French 26 Oct 87 p 7*

[Article: "ES2 Brings Telfin to Provence!"; first paragraph is ZERO UN INFORMATIQUE BELGIUM introduction]

[Text] The production of pilot series or small quantities of ASIC's [application-specific integrated circuits] using the direct electron-beam writing process has started in the Aix-en-Provence plant. A European first, in which Telfin is involved.

The aim is to offer the services of a plant capable of developing and producing dedicated integrated circuits in one month and at the best price. The idea dates back 2 years to the founding of a European consortium in which Telfin represents Belgium.

The plant is located at Rousset, near Aix-en-Provence. It started operations a few days ago. Its main asset: direct writing by electron beam, better known as E-beam.

In order to give small companies easier access to the design of personalized circuits, ES2 [European Silicon Structures] cooperates with franchise centers which already have experience in this field and could help the inexperienced client. When the latter is satisfied with the prototypes or the pilot series, he can call on the silicon founders for mass production. ES2 has signed agreements with Texas Instruments and Philips.

ES2 uses two kinds of tools: Solo 1000 for circuits with less than 5,000 gates and Solo 2000 for more complex circuits of up to 20,000 gates. The biggest demand is for Solo 1000, for circuits of 1,500 to 3,000 gates (70 to 80 percent of total business). These are relatively simple circuits with a rather low unit cost. The rest of the market is covered by Solo for the so-called "full custom" circuits. These require 6 to 8 months of study and yield a larger return than the simpler circuits.

Solo 1000 can handle all the design stages, from preparing the plan to manufacturing by E-beam, and it optimizes function development: Thus, a two- input NAND gate with VCC input will be replaced by an inverter; in the same way the MSI [medium-scale integration] function will be stripped from useless circuitry, the load function in a counter, for instance. Analog cells will be available by the end of the year.

Solo 1000's limitation lies in its simulation times: With a PC/AT up to 5,000 gates can be simulated, and with Sun or Vax equipment, gate simulation does not depend on the technological process but is handled at the transistor level. A circuit with 2 to 4,000 gates needs 3 hours in simulation.

Solo 2000 uses the standard cells from Philips and Texas Instruments. It allows the automatic generation of complex functions such as RAM's [random- access memory] or ROM's [read-only memory]. This tool's formation time is longer than the one Solo 1000 needs, 3 to 4 weeks versus 1 week, so that the study of a circuit is most often done jointly.

25012

## French Analysis of Speech Recognition R&D

*3698A088 Paris OBSERVATOIRE DES TECHNOLOGIES STRATEGIQUES in French Aug 87 pp 7-9*

[Report by R. Lavergne with the assistance of Andre Gilloire, Christian Gagnoulet, Guy Mercier, and Laurent Miclet (CNET at Lannion): "Speech Recognition"]

[Text] Subject: Text-based speech synthesis is now well developed, even if further progress is needed to make it readily acceptable to users (intonation problems, intelligent processing of a written text, etc.). Speech recognition is still the object of basic research, but industrial applications are increasing.

### 1. Technology

Work on speech recognition started around 1950 and researchers then thought that the problem would be easy to solve. In 1969, however, a renowned but discouraged Bell Laboratories scientist wrote that it seemed impossible to develop a system capable of speech recognition, either word by word or sound by sound. Fortunately, since then researchers have discovered new ways with more modest aims (not recognizing everything said by every speaker) and developments in microelectronics have been such that there has been significant progress both in speech synthesis research and in industrial applications.

The voice signal is first converted by means of a microphone into an "analog" electric signal (varying continuously in time), then, after conversion and "sampling" (segmenting into very brief time intervals), into a "digital" signal (roughly representing a succession of whole numbers easily handled by a computer).

This digital electric signal can be used either directly—designated "amplitude-time representation" (which requires a high sampling frequency in the 10 kHz range)—or, after processing, in the form of "frequency spectrum" or "spectral" representation (with a sampling frequency of 100 Hz). Whatever the signal used, speech recognition is the analysis of this signal in accordance with one of the following two methods:

— total recognition is the global recognition of isolated words (separated by at least 200 ms) or concatenated words belonging to a restricted vocabulary and spoken by a single person. A training period is necessary during which the user of the system must read aloud a list of words from a lexicon. Each word is acoustically analyzed as it is spoken and the result is stored in the memory. Subsequently, in the operational recognition phase any word spoken is analyzed and then compared to the words in the lexicon, and the most similar word is selected. This is the most commonly used system but the methods employed entail certain disadvantages (the need to read a list of isolated words, a vocabulary restricted to a few hundred words and thus a specialized vocabulary, a single speaker, etc.);

— "analytical" or "phonetic" recognition, more ambitious and not quite operational yet, includes two stages—in the initial phase, the recognition of the basic sounds which make up the language (the "phonemes") with an error rate that can be significant; in the second phase, the use of "higher level" information (lexicon of possible words, spoken phrase structure) to recognize the actually spoken phrase in spite of the above-mentioned errors in the constituent sounds. This method allows continuous speech recognition involving several speakers in addition to lexicon and syntax changes without an additional training period. One can imagine, however, the complexity of the problem calling for knowledge in fields as diverse as physiology, psychology, linguistics, acoustics, and computer science.

Speech recognition systems are currently available as electronic microprocessor-based cards or even as integrated circuits.

Recently, there have been developments such as the use of expert systems which take into account the knowledge of phoneticians, without having to translate that knowledge into algorithms (a specific sequence of calculations). Much research is being done in this field (phonetic theories, parallel architectures, audible signals, etc.).

### 2. Industrial Applications

Currently, man-machine interaction is only possible by using pushbuttons, keyboards, screens, or printers; but oral communication between man and machine in both directions is now being anticipated. This form of communication allows a greater visual and manual latitude thus permitting greater freedom of movement; it is also often more reliable since it eliminates typing and spelling errors.

In the industrial field, a speech recognition system makes it possible to control a robot or a machine tool, to enter data into a data processing system, to report data during an inspection or in the course of quality control, etc. In daily life, oral interaction, possible via the telephone network, would facilitate the access to various sources of information and the use of equipment in the office and at home ("smart houses").

Some observers forecast that in 1990 the world market in voice recognition systems will be Fr 20 to 60 billion; voice-operated typewriters alone could account for two-thirds of the market. Today about 100 voice recognition systems are marketed worldwide, compared to only 10 in 1978 and 2 in 1972 (first marketing year). About two-thirds of the systems are American design.

**3. Firms and Research Centers Involved**

In France, there is Vecsys (which in collaboration with LIMSI [Data Processing Laboratory for Mechanics and Engineering Sciences] in Orsay marketed the first voice recognition card in 1981), a small firm with a staff of 15 and a 1986 turnover of Fr 10 million; Crouzet, for the control of combat aircraft; Protheor, with its Tetravox system for the handicapped costing about Fr 10,000; X'Com, with the Seraphine multispeaker card designed by CNET [National Center of Telecommunications Studies] in Lannion; etc. In addition, many large firms and organizations are interested in voice recognition to meet their own requirements—Thomson, Renault, SNCF [National Railway Company], EDF [French Electricity Company], P&T [Post and Telecommunications], etc.

In the United States, in addition to the expected presence of IBM, specialized firms have entered this field—Votan, Scott, Speech Systems Inc., Kurzweil Applied Intelligence, and Interstate. In Japan, the firms primarily involved are Sharp, Fujitsu, NEC, and Hitachi.

Many laboratories are working in the field. The major ones are the research centers of Texas Instruments (Villeneuve-Loubet), IBM (Yorktown Heights, Zurich, Corbeil-Essonne, etc.) and, among the French firms involved, the laboratories of CGE [General Electricity Company] in Marcousis, Bull, Matra, Telic, Bertin, Ferma, Oros, the CNRS [National Center for Scientific Research] LIMSI laboratory , CNET (Lannion), ENST [National School of Advanced Telecommunications Studies], ICP (Grenoble), CRI [Communication Research Institute] Nancy, GIA (Artificial Intelligence Group) in Marseilles-Luminy, and CERFIA (Management Cybernetics, Shape Recognition, and Artificial Intelligence) in Toulouse.

The "Communication Parlee" [Spoken Communication] group of the SFA [French Acoustics Company] is endeavoring to promote available products. (Footnote)(SFA-CNET Lannion A, route de Tregastel, B.P. 40, 22301 Lannion Cedex, phone: 96 05 20 29)

**4. The Stakes**

Speech recognition technology has recently gone beyond the laboratory research stage and the stakes involved are twofold. There is the mastery of technology where France could excel through the many laboratories involved in relevant research, but the risk exists that the technology will be poorly utilized industrially (that is the sense of the argument which arose in 1985 regarding Martine Kempf's Katalavox). There is also the prospect of French firms introducing speech recognition in their manufacturing procedures and their products to increase their competitiveness.

25050

## French Stepping Up Neural Network R&D

### Analysis of Neurocomputer R&D

*3698A089 Paris OBSERVATOIRE DES TECHNOLOGIES STRATEGIQUES in French Aug 87 pp 10-12*

[Article by R. Lavergne in cooperation with Michel Weinfeld of the PNHE [Nuclear Physics and High Energy] laboratory of the Polytechnical School: "The Neural Network, or The Next Revolution in Data Processing"]

[Excerpts] Subject: Today's computers have an operating principle which differs little from, say, an abacus, with operations carried out one after another (sequentially). Human or animal intelligence, however, is based on a neuron-based nervous system which, it appears, can be imitated in new machines in applications that could revolutionize data processing.

**1. Technology**

"Neural" machines, or machines with a "neural network", have been contemplated since 1945 when major progress in neurobiology made it possible to understand a (small) part of how the nervous system functions. The notion of intelligence became ambiguous since, for example, mathematical calculations and expert valuations, formerly considered essential elements of human intelligence, were carried out by machines. Artificial intelligence currently uses languages, such as Lisp and especially Prolog, which are oriented toward description rather than calculation. However, these languages still run on sequential machines which are not really adapted to tasks considered to be intelligent, such as recognition of shapes, colors, sounds, and writing; learning of languages; and classification of complex data.

For the time being, prototypes of neural networks are being developed by simulation on conventional or parallel computers. But the next step, integrating an electronic neural network on a silicon chip, is about to be taken, and the speed of calculations which would then be possible would be revolutionary: A chip containing

1,000 neurons could do in 100 microseconds what a current minicomputer does in 10 seconds! Devices which will make it possible to consider building optical neural computers are also being developed (ENST [National Graduate School of Telecommunications], Orsay Optical Institute, etc.).

**2. Application in Industry**

The neural network machines should be particularly suited to applications such as recognition of shapes, writing, colors, and sounds; control of industrial processes; learning of languages; and classification of complex data. Small systems could equal the speed of supercomputers, such as those manufactured by Cray. Moreover, they would be sturdier than the current systems because their performance would not be affected by the destruction or malfunctioning of a few connections (thus military applications). Finally, they should be more user-friendly than conventional computers because their natural learning process is comparable to that of human beings and does not require detailed computer programs. Nevertheless, most applications are still in the research phase and it will probably be about 10 years before these machines can be routinely used.

**3. Interested Companies and Research Centers**

Japan has initiated a program for developing smart fifth-generation computers, and in the United States, AT&T, General Dynamics, TRW, and the Office of Naval Research, in particular, are especially interested in neural networks. Several companies have been established in the last few years for marketing systems which often operate on IBM PC/AT or compatible computers and are sold at prices which are sometimes under Fr 10,000 for the smaller systems. These companies are, for example, Hecht-Nielsen Neurocomputer (HNC) (founded in October 1986), Synaptics (January 1986), Neural Tech (1985), Revelations Research (1984), Nestor (1975), and Neuronics.

It is typical that research in France is particularly advanced in this field, but that there has been little reaction so far from industry, apart from Thomson. Among the research centers, CEN [Nuclear Study Center] of Grenoble, the ENS [National Graduate School] laboratories of Ulm, IMAG [Applied Mathematics and Data Processing of Grenoble], the ESPCI [Graduate School for Physics and Industrial Chemistry of Paris], the ENST [National School of Advanced Telecommunications], the laboratories of the Polytechnical School, the Orsay Optical Institute, and the Signals and Systems Study Group of Toulon can be mentioned. The first European conference on neural networks, Neuro 88, will be held in Paris in June 1988.

## Neural Network Meeting

*3698A089 Paris OBSERVATOIRE DES TECHNOLOGIES STRATEGIQUES in French Aug 87 p 1*

[Article: "From Brain to Integrated Circuit: The Neural Networks"]

[Text] Michel Weinfeld (PNHE laboratory-VLSI [very large-scale integration] group-Polytechnical School) held a conference on this subject on 4 November 1987; it was organized by the SEE [Society of Electrical and Electronics Engineers] and the IEEE [(U.S.) Institute of Electrical and Electronics Engineers], at the Polytechnical School of Palaiseau. The subject had already been touched on in the "blue cards" in August 1987. He insisted especially on the precompetitive nature of this new technology, which is beginning to make the headlines in U.S. newspapers. It should be noted that the planned applications cover recognition of shapes (images, sound, radar signals, etc.), signal processing (data compression, troubleshooting), knowledge representation and management, robotics, "optimization," and artificial intelligence. The first European conference on neural networks, Neuro'88, will be held in Paris on 6-9 June 1988 (for further information, contact G. Dreyfus and L. Personnaz on (1) 43.37.77.00 at ESPCI [Paris Graduate School for Industrial Physics and Chemistry]).

25053

## Bull Director on European Technology, OSI Standardization

*3698A070 Paris ZERO UN INFORMATIQUE in French 2 Nov 87 p 11*

[Article signed P.A.: "International Press Conference—Jacques Stern: 'All or Nothing for Europe'"; first paragraph is ZERO UN INFORMATIQUE introduction]

[Text] In a one-hour geopolitical marathon, Jacques Stern presented a picture of Europe's strengths and weaknesses in light of the economic challenge of the open market in 1992.

A man of high ideals, broad-minded and very persuasive, Jacques Stern is the champion of Bull's recovery. Still crowned with the laurels of his recent triumph, he managed to make his public forget that he is a company man. Faced by representatives of the international press (from the FINANCIAL TIMES to LE MONDE), Jacques Stern appeared as a great strategist.

Mixing historical perspectives and economic landscapes, he virtually dealt with every subject—taking the opportunity to explain his views of the world through often simple questions—from the technological challenges to national education to the history of Japan.

The 1992 deadline? For Jacques Stern, this is not a risk, it is an opportunity. An enormous market is about to open (Europe represents 30 percent of the world data processing market) and the chances of success are greater than the risk of failure. For some 30 years, all the errors have been accumulated and it is not vain to hope that they will be avoided this time. At the beginning of the 1980's, European manufacturers were totally unaware of each other. What has changed is that today they are ready to pool their strengths.

From now on European manufacturers know how to cooperate, at least at the precompetitive stage—the joint ICL/Bull/Siemens research center is a good example of this. However, institutional funding remains modest: ESPRIT II, which is experiencing some start-up difficulties, represents only about 15 days' worth of European agricultural expenditure.

Faced with the challenge of 1992, the authorities should broach one key question: They must acknowledge the importance of research and development in civilian technologies.

Compared to the military domain, this decisive sector is—in every sense of the term—the poor relation in Europe. In the United States, the Department of Defense (DOD) finances 70 percent of civilian R&D ($1.3 billion). As for the Japanese MITI [Ministry of International Trade and Industry], they have invested no less than $700 billion for data processing alone (obviously for civilian applications). In Europe nonmilitary R&D expenditure represents barely 1.36 percent of the GNP compared to 2.6 percent in Japan.

Why does the DOD fund civilian R&D if not because it has understood that it is the technological foundation on which its own industry will prosper? This investment has already borne fruit in the fields of space and aeronautics where we often appear as the leader. Indeed, there are already sectors of the data processing industry where Europe is on an equal footing with the United States or Japan. But there remain technological deserts and this is deplorable. Microprocessors or VLSI [very large-scale integration] technologies are areas of absolute dependence, which make Europe's fragility patently obvious. This must come to an end.

Another fundamental point is the application of common standards. According to Jacques Stern, it is necessary to impose OSI [Open Systems Interconnection] standards on all the calls for bids. This is not a protectionist step inasmuch as it is an open standard.

Far upstream from industry is education, which also constitutes a key problem. Qualitatively and quantitatively, we are not training young people as well as our competitors. Companies must become aware of their responsibilities in this field. We should not "leave education and research in the hands of the state and teachers." A tricky question because who must take the first step and what should be done?

"There is many a privatization going on at the moment, but as far as education is concerned, it is the government which should be privatized...and I have not yet found a way to privatize the government!" These are the collective models of behavior which are being questioned: Perhaps we should be humble enough to learn from cultural models different from our own. Japan, so highly praised today, has not behaved otherwise since its opening in 1868

25041 .

## Netherlands Government Funds R&D on Airflow, Waterflow Simulations

*3698A104 Zoetermeer SCIENCE POLICY IN THE NETHERLANDS in English Sep 87 p 19*

[Unsigned article: "Research Institutes and Universities Making Waves Together"]

[Text] Currents in non-solid substances, for instance the airflow around aeroplane wings or the movement of water around propellers or off-shore rigs, are particularly difficult to calculate by computer. Many researchers would very much like to have a good simulation programme for such currents, however. Four major technological institutes and two universities are therefore cooperating on the ISNaS project—an information system for simulating currents, based on Navier-Stokes equations.

As minister responsible for science policy, Mr W. Deetman, the Minister of Education and Science, has announced a total grant of 4.5 million guilders for this project. The grant will cover the years 1987 to 1991 and 2.5 million guilders will come from the Ministry of Education and Science. The Public Works Department and the Civil Aviation Authority will each contribute one million guilders.

The Navier-Stokes equations, formulated in the 19th century by two physicists and mathematicians, describe the internal cohesion of a liquid or gas. To date computer simulations have only been able to give simplified representations of these equations. The ISNaS simulations are to contain and process all elements of the equations so that they can arrive at a complete picture of any current.

The establishments working on this project are the National Aerospace Laboratory (NLR), the Netherlands Energy Research Foundation (ECN), the Maritime Research Institute (MARIN), the Hydraulics Laboratory (WL) and the Universities of Delft and Twente.

## Philips Restructures Along Japanese Management Methods

*3698A050 Paris L'USINE NOUVELLE in French 5 Nov 87 pp 86-87*

[Article by Patrick Franklin: "Philips—Japanese-Style Metamorphosis"; first paragraph is L'USINE NOUVELLE introduction]

[Text] The Netherlands electronics giant has changed its method of operation thanks to "Kaizen," a management method imported from Japan. It is based on the analysis of the manufacturing process and should enable the group to attain total quality.

In-depth changes are taking place at Philips. In a worldwide market with worldwide competition, the Philips group is putting an end to a scattered, somewhat "federal" structure in which each of 60 national companies works for its own market. Cornelius van der Klugt, chairman of Philips NV, is seeking a global approach which favors product lines to challenge the electronics market. But behind this reorganization there has been an effort over the past 3 years designed to change the behavior of men, the 340,000 employees who make up Philips.

To be able to match the Japanese, the managers of the Netherlands multinational went to Japan in search of ideas. There they found a consultant, Masaaki Imai, and a method, Kaizen, which, through the concept of total quality, sees itself as a management philosophy. According to those at Philips, "this is all the more important because 80 percent of defects in quality are attributable to errors in management. Kaizen has changed our personnel and production management techniques." Kaizen sees itself as going beyond the usual methods of product quality control by focusing above all on the operation of the company itself through TQC, Total Quality Control.

In 1983 Willy Dekker, then Philips president, stated that he wanted to "lead the entire company vigorously toward quality improvement." This thrust resulted in the establishment of the Corporate Quality Bureau reporting directly to the board of directors. It was Joop Bokern, the first chief of the bureau, who brought the name of Masaaki Imai back from a trip to Japan. His message is simple, though surprising: The product is first a means of measuring design and manufacturing quality. Attention must therefore be paid to the process.

A process of training and education then begins. It is done with great caution, however, to avoid shocking Europeans by imposing too harshly on them a Japanese technique employed by quite a few of their competitors.

Everything is placed in motion. Dozens of internal newsletters are activated; posters abound; one seminar follows another; the Kaizen concept takes shape.

Are the results significant? "Yes, our manufacturing costs have declined by 3 percent over 2 years as a result of progress in this area," stresses Jochen van der Sloot, director of the technical center of the medical equipment division at Eindhoven. The production manager for medical imaging electronic cards points to the results: Between 1982 and 1987, a reduction of 5 minutes in production time per card, of 7 minutes in test time, and a 12-percent improvement in the zero defect rate which today is 92 percent.

What is quantifiable for products is not quantifiable for services. But Kaizen is equally applicable in that area. In an Eindhoven headquarters facility where telex traffic reached an hourly peak toward the end of the day, overloading the operators and leading to errors and delays in message processing, the situation was analyzed from the standpoint of quality. The analyses revealed the propensity of the commercial services to send their telexes at the end of the afternoon, even though many of them could be sent in the morning. A simple reorganization made it possible to stagger the traffic flow. "With the Kaizen method," says Hans Jager, the current chief of the Quality Bureau, "it is the employees themselves who study the problem, find the defect, and suggest solutions."

**[Box, p 86]**

**Kaizen's Five Tools**

Kaizen is coming to France. Masaaki Imai, the method's developer, will be conducting a seminar in Paris on 27-28 January 1988. Kaizen is a management concept with which five tools are associated:

— Definition of cause and effect relations on the production line for diagrammatic analysis of complex situations;

— Group meetings to gather ideas, which are organized graphically on the basis of the topics addressed;

— Matching stated goals with available resources;

— Development of specifications for the establishment of quality standards at the design stage;

— Planning of project decisionmaking. A work schedule is drawn up and results are matched against forecasts.

**[Box, p 87]**

**Philips' New Structure**

Philips is carrying out a change which is probably unique in the history of multinationals. In order to coordinate energy resources and capabilities, avoid production surpluses, improve productivity, enhance the firm's standing in highly competitive markets, and refocus its efforts on electronics, the field of its true expertise, Cornelius van der Klugt has embarked on a reorganization at the end of which 10 product divisions will have worldwide capability in the fields of merchandising and marketing; their policies will govern the 60 national companies.

At the heart of the reorganization are three new divisions: consumer electronics, components, and data processing telecommunications. Around these major activities, seven other divisions will develop with greater independence; they will even be able to enter into joint ventures. It is in this vein that the medical equipment division is to conclude an agreement with the General Electric Company of Britain.

25050

## ENERGY

### EC Database on Energy Policy Inaugurated

*3698A125 Brussels EC PRESS RELEASE in English No IP(87) 576, 16 Dec 87 pp 1-2*

[Article: "SESAME Data Base Opened to Public: Hundreds of Useful Information on Energy Technology Projects"]

[Text] The new European Community data base, SESAME, has just been opened to the public thus providing access to information on the many hundreds of innovative energy technology projects.

In response to the oil crises of the 1970's, the European Commission's Directorate General for Energy set up two innovative energy technology programmes which together account for Community support of 1,000 million ECU and have stimulated a total investment of many times that figure.

The first of these, the hydrocarbon technology programme, was set up in 1973 with the aim to improve the conditions for ensuring long-term safety of hydrocarbons supply to the Community. This programme provided financial support to some 600 projects to develop innovative techniques used for exploration, production, transport and storage of oil and gas. A large number of the projects have led to the commercialisation of the results. SESAME helps with the process of dissemination of information by giving concise but essential details of all ongoing and completed projects. Commercialisation and setting up of cooperation by European companies will be greatly enhanced.

The second programme contained in SESAME is the Community Energy Demonstration Programme. Since its inception in 1978, nearly 1,500 projects have been accepted for support. The 4 major fields covered are:

— efficient use of energy,

— renewable sources of energy,

— hydrocarbon substitution by solid fuels and by electricity and

— liquefaction and gasification of solid fuels.

A demonstration project is intended to bridge the gap between successful R&D and commercialisation by proving both the new technology and the economics at realistic scale.

As with the successful Hydrocarbon Technology Programme many of the demonstration projects have already led to widespread commercialisation of energy technology; SESAME contains the information to enable industry and commerce to discover and keep abreast of innovative energy technologies suitable for use or commercialisation by them.

SESAME is a "live data base" as it is constantly being updated, thus allowing its clients to keep track of projects right through from their inception to their completion. It also contains valuable information on undertaking exploiting innovative energy technology together with names of equipment manufacturers involved in the design development and implementation of this technology.

SESAME provides an opportunity for organisation looking for partners in joint ventures licencies and export.

SESAME is available worldwide by agreement with the Commission of the European Communities, from the Danish Host Organisation DATACENTRALEN.

Address: DATACENTRALEN

att. DC Host Centre

Landlystvej 40

DK-2650 HVIDOVRE

Telephone: 45 1 758122

Telex : 27122 dc dk

Telefax : 45 1 750550

to whom application should be made for details on how to access SESAME.

## FACTORY AUTOMATION, ROBOTICS

### FRG's Nixdorf, Volkswagen Share CIM Strategy

*3698a112 Paris L'USINE NOUVELLE in French 3 Dec 87 p 35*

[Article by Rene Frion: "Nixdorf Goes to War for the Factory of the Future"; first paragraph is L'USINE NOUVELLE introduction]

[Text] Its technical center, devoted to the computer-controlled factory, has 800 clients. The German computer firm has already signed several contracts with major companies, including Volkswagen.

Computer protagonists rush to factory gates. Insignificant only a little while ago, the factory automation market is becoming the major basis of development in the software industry. Witness the success of the "ProDECtique 87" conference which was organized this week by DEC, or the latest IBM, Hewlett Packard, and Unisys initiatives in the field of industrial data processing or CAD [computer aided design].

The German Nixdorf, which is relatively new in this field, has opted for an ambitious approach: a brand-new technical center entirely devoted to CIM (computer integrated manufacturing). A global concept: the factory of the future totally controlled by computer, integrating computer assisted production control, production planning, CAD/CAM, etc. Nixdorf sees all these applications, although today still isolated, as steps toward a general CIM approach and offers them as such to its customers, even to the smallest ones.

An approach which seems effective since the Stuttgart technological center will soon have a staff of 500, compared to a mere 40 at the beginning.

However, the CIM market is not clearly defined: There is no standard and no one can provide statistics on it. "It is exactly because the market is undefined that we take our positions from now on," explains Hans-Joachim Mosler, Nixdorf technical center director. "Our idea is to take an active part in defining the CIM concept." The company considers it essential to remain the leader in Europe in the years to come.

Nixdorf is determined to bring out the big guns to gain a position in the market. Its strategy is somewhat trite: to build as many installations as possible in order to acquire the know-how that will give it supremacy. For the time being Nixdorf is doing very well; the Stuttgart center already has close to 800 clients of all sizes. The orders from small- and medium-sized companies already amount to Fr 350 million. "The managers that come to see us do not leave here with a complete CIM system for installation in their factories, but they can computerize entire portions of their production control with the idea of adopting CIM one day."

As for the major companies, juicy contracts have been signed. Some have agreed to function as pilot installations for Nixdorf, for instance the Mahle subcontracting company in the automobile sector (a Fr 50-million contract) and even Volkswagen (Fr 100 million).

The German computer firm also shows that it does not intend to offer spectacular innovations but above all installations that work. In this way the firm increases its know-how and immediately takes its place in the CIM market. Nearly 5 percent of its turnover (i.e., almost Fr 800 million) already comes from this business sector. A promising start since manufacturers invest step by step. The major companies such as Volkswagen which have signed a first contract for equipment with Nixdorf will not leave it at that....

25048

## MICROELECTRONICS

### New Eureka Project To Develop Automated Chip Inspection

*36980153b Paris ELECTRONIQUE ACTUALITES in French 22 Jan 88 p 8*

[Article: "IMAGIA: A New Eureka Project for Integrated Circuit Control"]

[Text] The IMAGIA project (Inspection Machine for an Automated and Genuine Intelligent Analysis of Semiconductors) was given the Eureka label by the council of European Research Ministers which recently met in Madrid.

The project is the outcome of French-Swiss cooperation; its partners are two French companies, Bertin and Serge Dassault Electronics, plus the Swiss Electronics and Microtechnology Center (CSEM) and the Wild Leitz group.

With a total budget estimated at Fr100 million, IMAGIA is expected to market, by 1992, a system that would provide automatic quality control of integrated circuits, using in particular artificial intelligence techniques; today, IC control is mostly a purely visual inspection.

In order to identify the features of a size much smaller than 1 micron that will characterize the circuits of the 1990s, the system will use the most advanced image acquisition devices. The images observed must then be processed electronically and then interpreted by an expert system which will sort out what is acceptable and what is not, based on experimental criteria.

Thus to separate "the wheat from the chaff," the expert system will use not only the knowhow of experts in semiconductor manufacturing, but also the very same computerized data that will be used to produce the circuits.

The system will therefore be particularly well suited to the inspection of ASICs (a market that is booming) which are usually produced in relatively small series and pose very specific control and testing problems.

The consortium was formed specifically to regroup the diversified and complementary expertise required for such a project. The prime contractor is the Swiss company CSEM, a designer and producer of ASICs. Two companies will be in charge of the optical part: the Wild Leitz group, a world leader in industrial optics, and Bertin, which will contribute its expertise in image processing; Serge Dassault Electronics will be in charge of the artificial intelligence part and will contribute its 15 years of expertise in the field of ASICs.

As it prevents any scattering of efforts, to which none of the partners would probably have agreed, the gathering of these capabilities reflects, according to the four partners, the very purpose of the Eureka program, "and there is no doubt that, despite the technical risks involved in this ambitious project, such a synergism should enable the European industry of 1992 to take over an additional position in the large economic battle that is already being fought worldwide in the field of advanced technologies," they added.

9294

## November 1987 Marketing, Organizational Plans of SGS-Thomson

*36980153a Paris ELECTRONIQUE ACTUALITES in French 27 Nov 87 pp 1, 14*

[Article by D. Girault: "Mr Pistorio Outlines the Policy and Organization of STM"]

[Text] At a press conference held in Paris on 24 November, Mr Pistorio outlined the internal organization of the new STM entity (SGS Thomson Microelectronics).

In view of the Asiatic and more especially the Japanese competition, he particularly emphasized the necessity to increase productivity, the goal being $60,000 per employee by the end of 1988, and $70,000 for 1989. In addition, referring to a Japanese marketing vision which he called a "system," he advocated a negotiation on equal terms, with European authorities intervening to put a stop to any dumping and, implicitly, to give "credibility" to Europe which has been kept out of the U.S.-Japanese agreements. This statement did not at all rule out the possibility of a cooperation with a Japanese company. This approach, should it materialize, would then be like the one initiated by Motorola to conclude its agreement with Toshiba.

### "$60,000 per Employee by the end of 1988"

To be competitive on the international market, according to Mr Pistorio, STM must achieve sales of $70,000 per employee. It should reach that goal in 1989. It is already expecting to reach $60,000 per person in 1988, starting from $44,000 per person last May, when the SGS/Thomson Semiconductors agreement was signed. Mr Pistorio did not conceal that, to achieve this result, the company would have to reduce its personnel and increase its sales, and he mentioned that, to date, a total of 800 jobs had been abolished in Italy, France, the United States and the Far East. The STM executive also stated: "Today, we are employing 17,800 people; in 1 year from now, I do not know." The projected 353 layoffs at the St-Egreve and Grenoble units, which the unions mentioned, could be a reflection of this trend.

### Prime Contracting and Production Concentration, at the Lowest Cost

The number of plants will also be reduced: At the time of the SGS/Thomson agreement, STM owned 23 plants but, according to Mr Pistorio, in order to become competitive sales must reach about $150 million per plant. Now, STM's 1988 goal is $1 billion in sales with 20 plants (since some rationalization has already taken place), which implies sales of $50 million per plant. "The number of plants will have to be divided at least by two.... In 1989, we shall be able to approach the market as a fully restructured company."

As far as the internal organization of STM is concerned, it is an exact replica of that of SGS, which was hailed as the best by Mr Pistorio; having spent 17 years at Motorola he was in a position to evaluate the various organizations in terms of their performance.

It is therefore a matrix grid which Mr Pistorio is proposing for STM, with region and product line "entries," and the managers in charge reporting directly to the STM executive.

There are four regions: Asia, accounting for 15 percent of 1987 sales; the United States (including the "Mostek" spearhead now headed by Mr Queyssac, and Phoenix which is "kept as a reserve" to meet the increase in volume of 0.8-micron and 0.5-micron CMOS components now being developed), accounting for 20 percent of the market; Europe (with, therefore, 65 percent of the market); and the headquarters, which are designed to serve clients who do not belong to the other regions.

As far as product lines are concerned, Mr Pistorio indicated that they are divided into six sectors, each with its own headquarters; "expertise modules" are retained to contribute their knowhow. Thus, "standard discrete and logic components" have their headquarters in Catane, dealing in particular with power transistors, although the knowhow accumulated for this sector of activity is still preserved in Aix-en-Provence. Note that for power electronics components "other than transistors," the prime contractors are the Tours and Aix facilities. As for production, it will take place wherever cost is the lowest and production capacity is available. Taking the Catane, Aix and Singapore sites as an example, Mr Pistorio indicated that the decision to manufacture in Singapore had been motivated by a 40 percent gain on the cost of circuit boards compared with the cost at the other two facilities. The remaining product lines include telecommunications, automobile and industrial dedicated circuits (Agrate), video dedicated circuits (Grenoble), VLSI circuits (Rousset), and digital ASIC's which are entrusted to Innovative Silicon Technology, while Grenoble gets the linear circuits. We shall come back later on this division.

### "Getting One's Shares of the Japanese Market"

Mr Pistorio indicated his firm intention to enter the Japanese market, as he does not accept that Europe as a whole should become a casualty of the U.S.-Japanese agreements. According to him, at a time when sales involve politics, it seems imperative that Europe should organize to form a "system" capable of negotiating on equal terms with the Japanese "system." This is why the STM executive advocates energetic measures on the part of the EEC against any form of Japanese dumping, as well as negotiations to arrive at agreements similar to those signed by the United States and Japan in August 1986: "Europe must be allowed to enter the Japanese market, and that 20 percent share of the Japanese market must not be reserved solely to U.S. manufacturers!"

This does not preclude, quite to the contrary, that Europeans could sign so-called "strategic" agreements with the Japanese. Especially as expertise in key technologies is a must. Thus, when asked about the production of DRAMs and 32-bit microprocessors, Mr Pistorio implied that an alliance between STM and a Japanese company was not ruled out, "as the TRON architecture was not rejected."

These selection criteria evoked (maybe too readily) the possibility of a cooperation with Hitachi. But the Thomson/Motorola agreement is strong, and Mr Pistorio's statement might just be an indirect way of reminding U.S. companies that they might want to cooperate with STM...

9294

## Europeans To Build Synchrotron in Grenoble

*36980128 Copenhagen BERLINGSKE TIDENDE in Danish 28 Dec 87 p 4*

[Article by Jens J. Kjaergaard: "Denmark Included in European Superresearch"]

[Text] In Grenoble in the south of France a new device, a so-called synchrotron, will produce X-rays 10,000 times more powerful than previously possible. This will provide new knowledge and make it possible to construct larger computers.

Nature will have fewer secrets as a result of the enormous joint European research project, which will be initiated at the beginning of the year. Denmark is participating in the project, called ESRF, which should make it possible to produce lightweight supercomputers. The device, a so-called synchrotron which will cost 4.1 billion kroner, is now being built in Grenoble in the south of France.

Synchrotrons are rings of powerful magnets in which electrons or heavy ions are accelerated to enormous velocities.

The device in Grenoble will produce X-rays 10,000 times more powerful than previously possible.

The radiation has such a short wavelength that it can draw unbelievably fine circuit patterns on microchips for use in computers.

Danish researchers are extremely interested in participating in this work. For a long time they hoped the facility would be located at Riso, but the French bid was more attractive.

Agreement on the research project was reached at a meeting in Paris, where newly appointed assistant director Jorgen Kjems of Riso represented Denmark, Norway, Sweden, and Finland.

The negotiations on the financial arrangements were not without drama, according to Jorgen Kjems. In a footnote to the meeting, Great Britain's authorities in London wanted to pay only 10 percent of the costs, rather than the 14 percent demanded by France and Germany. The negotiations were on the verge of collapse when everyone came to their senses. Now the English researchers have their foot in the door.

The agreement is expected to be approved at a meeting of the Nordic Council of Ministers on 7 January.

Together, Denmark, Norway, Sweden, and Finland will pay 4 percent of the total expenditures over a period of 11 years.

Denmark will spend 1.5 million in 1988. After that, the price will increase, to 7 million in 1990. One third of this amount will be spent on research, Kjems said.

Up to now, Danish researchers have been using a large German facility in Hamburg.

09336

## Thomson of France Presents Latest Flat Panel Display Work

*36980153c Paris ELECTRONIQUE ACTUALITES in French 15 Jan 88 p 16*

[Article by G. Cuciuc: "For 'High-End' Military and Civil Applications, Thomson-CSF Counts on Specially Adapted Flat Panel Displays"]

[Excerpts] For the Electronic Tubes Division of Thomson-CSF, developments in the field of "high-end" military and civil equipment displays in the next few years will require specially adapted monochrome and color flat panel displays (plasma or electroluminescent displays). With this in mind, Thomson-CSF, which has deployed considerable resources to ensure production of these displays, organized a technical presentation for its clients, on 15 December 1987, at its Boulogne premises, near Paris. The presentation included all of the company's "special components" for current or future flat panel displays (showing the operation of already marketed and prototype components).

They showed, also in operation, the latest developments in this field, the most recent monochrome plasma display, the largest of all, the THX-943 which has a useful area of 43 cm x 43 cm, with 1,280 X 1,280 pixels at a pitch of 0.33 mm.

They also showed the mockup of a green alternating plasma display, 128 X 128 pixels (the green color is obtained by embedding a continuous layer of phosphor within the plasma panel), the first stage of a project supported by the DGA [General Delegation for Armament]. The mockup uses the ultraviolet radiation from a

gas discharge to excite phosphor through photoluminescence. According to Thomson-CSF, this first development paves the way for three-color screens with up to 1,024 X 1,024 electrodes in a first stage. High-voltage integrated circuits were also developed for plasma screens under a DEI/STEI contract; they can provide the voltages required for large-size screens with a high access rate. Half-tones can already be obtained on small screens without any loss of resolution. Using these components, which represent the first part of the "puzzle, it is already possible to consider making large and medium-size color plasma screens costing about the same as present monochrome screens, but Thomson-CSF cannot yet indicate a date (1990?). Later on, the research program will materialize, already in 1988, in the "rainbow" plasma panel that will restitute a palette of seven different colors (red, green, blue, yellow, turquoise, purple and white). The objective is to offer color plasma panels up to 60 cm in diagonal and with over one quarter of a million of polychrome pixels. Note that with the advent of color, plasma flat panels should be used increasingly not only to display text or graphics in data- processing systems, but also in C3-type military applications which must, for instance, display digitally memorized geographical maps, etc. Indeed, compared with the traditional cathode ray tubes and other flat panel display technologies, plasma panels offer numerous advantages, such as large size and small space requirements, sturdiness and good resistance to difficult environments, plus high definition (over one million pixels).

### Active Matrix Color Liquid Crystal Displays

For medium-size monitors, the solution of the future consists in using active-matrix color liquid crystal displays. Prototypes with over one million addressable points were also shown at the technical presentation. The basic technology uses transistors on a thin film of amorphous silicon and specific mixtures of liquid crystals in the twisted nematic mode. Color is obtained through a mosaic of filters. This concept is characterized in particular by its reduced electric consumption, its good visibility under strong illumination at 100,000 lux (the data can be seen in bright sunlight, at an altitude of 10,000 km), direct row and column addressing through a switching element, etc.

As is known, this new screen family, for which no series production is contemplated before 2 or 3 years, is the result of cooperation between Thomson-CSF, General Electric and VDO-Luftfahrt. A joint subsidiary, Eurodisplay, owned 60 percent by Thomson-CSF and 20 percent by VDO, was created specifically for that purpose. It is in charge of new product design and production. The addressed cell, i.e. the liquid crystal cell, its addressing system and connectors, will be manufactured by PRODIS, a newly created French company, whose stock is held 50-50 by Eurodisplay and General Electric.

9294

## SCIENCE & TECHNOLOGY POLICY

### French Pechiney To Build Two Plants in USSR

*3698a114 Paris L'USINE NOUVELLE in French 3 Dec 87 p 129*

[Article by Yves Mamou: "Joint Venture—Pechiney on the Threshold of the USSR"; first paragraph is L'USINE NOUVELLE introduction]

[Text] The French firm, together with the Soviet state, is on the verge of creating two packaging firms with joint capital.

"Perestroika" is no illusion..., but it is proceeding tentatively. Thus, for 9 months Pechiney (Fr 37.3-billion turnover in 1986 in the aluminum, packaging, and advanced materials sectors) has been negotiating with the Soviet Government for the creation of two packaging firms with joint capital (joint venture). This project is close to being signed and could be the first joint French-Soviet venture involving a major company.

The first plant, located in Armenia, would manufacture food packing materials in aluminum, whereas the second industrial site would produce pliant aluminum tubes for the agro-food and cosmetic sectors. Neither case would involve the acquisition of a turnkey plant, but rather a marriage between the Pechiney group and the Soviet state inspired by market forces.

The negotiations were begun in March 1987 with a declaration of intent whereby the two parties intended to determine the packaging needs of the Soviet society and to secure the general legal framework for the creation of a joint company. In July 1987, after numerous trips, meetings, and discussions, they worked out a feasibility study, a draft agreement for the creation of a joint company, and especially its legal status.

The funding procedure (several hundred million francs) has not yet come to a close and therefore remains a secret. However, Pechiney and the Credit Lyonnais will hold less than 49 percent of the total shares. In addition to the French and Soviet capital contributions, loans (in the form of trade credits in francs and ECU's) will be contracted from a pool of French banks exclusively through the Uneshtorgbank (Soviet Bank for Foreign Trade)—which is a major innovation. The funds will then be transferred to the joint company..., provided it promises to reimburse the capital and interest.

This company, which produces especially for the domestic market, will obtain the necessary foreign currency for itself by retaining part of its production for export. According to Serge Rasovlef, delegate from the East Bloc countries at Pechiney, it is less a matter of collecting foreign currency than proving the quality of the imported technology to the Soviet Government, while sharing in the benefits from the French-Soviet company. The rest of the foreign currency will come from the

Soviet Government. The dollars previously spent on packaging material imports will be allocated in part to the new French-Soviet plant which will use them to service its debts.

These negotiations are complicated and Soviet officials prefer to cover themselves before taking any initiative. Hence the delays. However, officials are said to have clearly expressed their willingness to use the occasion to form a group of managers experienced in the ways and customs of the international market. Comrades, another effort for the liberal revolution!

25048

## FRG-Hungarian S&T Cooperation

*3698a120 Paris L'USINE NOUVELLE in French 17 Dec 87 p 178*

[Text] The German and Hungarian Governments have signed an important agreement of S&T cooperation. Thirty-two joint research projects have been worked out; they focus particularly on the priority areas of the Hungarian 5-year plan (1986-1990): energy and raw materials, electronics and biotechnologies. Although Hungary wants to accelerate technology transfer, the FRG's interest in this agreement is much more commercial than scientific.

25063

## EC Reports on BRITE Program Achievements

*3698A124 Brussels EC PRESS RELEASE in English No IP(87) 580, 18 Dec 87 pp 1-3*

[Article: "BRITE Technological Days"]

[Text] Almost 1,200 participants from all Member States took part in the first BRITE Technological Days which have been taking place in Brussels this week. The number was far more than expected, reflecting the high level of interest in BRITE shown by European industrialists. It has provided a major forum where existing and potential partners in BRITE were able to exchange information and experiences, and where the first results of some 25 projects were presented in public.

Opening the BRITE Technological Days, Vice-President Karl-Heinz Narjes stressed the importance of BRITE for encouraging the use of new technologies in the "sunshine" industries (motor vehicles, chemicals, aeronautics, textiles, plastics, furniture, food and drink, etc.). These sectors still make a major contribution to the Community's combined DGD, and account for 25 percent of Community employment.

BRITE (Basic Research in Industrial Technologies for Europe) has only been running since 1985, and yet it has already been successful in creating a climate of close cooperation in industrial technology, and has thus contributed to the development of a genuine common market in the Community.

Vice-President Karl-Heinz Narjes also announced that plans were being made for the successor programme (BRITE 2) which should be ready for a Council decision in the second half of 1988. It is expected that BRITE 2 will have a budget of up to 340 million ECU, which is more than twice the amount to be spent in the current programme.

Industrial design and manufacturing techniques can no longer be separated from the development and application of new materials. Consequently BRITE 2 will be planned in collaboration with the next EURAM programme on advanced materials. Taken together, there is the prospect of a coordinated successor programme covering industrial technologies and advanced materials with a budget of 500 million ECU.

### Some Examples of Research Results Emerging From BRITE

Around 150 projects are currently financed by the Community on a 50:50 cost share basis with industry. About 100 of these have now been running for two years and are now beginning to yield concrete results. The Commission has already given details of some of the earliest results in its press release of 24 September 1987 (No IP(87) 389). During the BRITE Technological Days, results emerging from many more were presented. The following is a sample:

### New Methods To Detect Faults in Reinforced Concrete Structures

With the widespread use of reinforced concrete in a variety of building structures (e.g., motorway bridges), it has become necessary to develop techniques which give plenty of advance warning of incipient structural failure. A project with partners in West Germany, Belgium and Ireland has developed a method which involves embedding optical fibre sensors in the concrete while it is being pre-stressed. The data provided by these sensors is analysed by computer in order to obtain "early warning" of faults.

The project has also developed techniques for bridges which already exist, especially those built during the last forty years and which now need careful inspection: the first involves the use of an "exiter" to send vibrations down the bridge. Damage to the concrete causes decreased stiffness and increased energy losses. Electronic sensors pick up the vibrations and a computer analyses the data to determine fault location. Computers have also been used to analyse the sounds emitted by concrete structures in order to detect damage.

### Development of New High-Temperature Composite Materials

In the aerospace industry, among others, there is a need for special materials which can withstand high temperatures (250-300 degrees Celsius) and which have good mechanical properties (strong, lightweight, resistant to micro-cracking, etc.).

Composite materials made by "curing" woven fabrics impregnated with epoxy resins (polymers) have become established as high performance structural materials; and of the high-temperature resins PMR-15, polyimide has been the frontrunner. But there are several drawbacks to polyimide-based composites: micro-cracking, high curing temperature, toxicity and brittleness.

Four BRITE partners in West Germany and the UK have developed a new polyimide matrix resin with similar high-temperature properties to conventional PMR-15, but with significant improvements: less susceptibility to micro-cracking, less toxic, tougher, and low temperature processability.

### Biocompatible Polymers

Partners in the UK and Belgium have developed new biocompatible and blood-compatible polymers which can be used to make a wide range of medical equipment: artificial hearts, valves and blood vessels; blood containers; ophthalmic devices and urinary catheters.

This is done by coating the surfaces of ordinary polymers with chemical compounds (e.g. phosphorycholine) which mimic the outer surface of red blood cell membranes (which are biocompatible by definition). This stops the artificial material from absorbing proteins, and from causing blood to clot.

These polymers have also been used to coat contact lenses to reduce the level of protein deposits on the surfaces (the characteristic "cloudy" effect often seen on lenses). This prevents vision impairment, discourages bacterial growth and makes the lens comfortable to wear for longer periods of time.

### Accelerated Ageing of Plastics Using Laser

Plastic components used both indoors and outdoors are subject to ageing. Sunlight, temperature, oxygen, water, pollutant gases, mechanical stress and biological agents acting alone or in combination can cause the failure of certain plastics. Since the required lifetime of many plastic components often exceeds 10 years, there is a continuing need for accelerated ageing tests on the ever increasing number of new plastics and formulations.

Presently, available artificial ageing equipments provide typical acceleration rates of only 2:1 to 5:1. But, the partners in this project (France, Italy, FRG, UK) have developed a laser technique which has increased acceleration rates up to 1,500:1 compared to existing techniques, and 300,000:1 compared to natural ageing. A variety of plastic and paints are now being tested in different conditions for applications in the car and telecommunications industries.

### Adhesive Bonding Technology for Car Manufacture and Other Engineering Applications

This project has developed the basic technology necessary to introduce adhesive bonding in vehicle construction and the mechanical engineering industries.

Adhesive bonding enables stiff joints which, when subjected to applied loads, produce stresses in the components which are lower than for joints made by other joining techniques. There is potential weight saving in materials, but the application of this technology has been until now largely limited to aircraft construction.

The project has involved the computer selection of the latest adhesives and their incorporation into bonding joint design procedure. Basic configurations have been established so as to produce methods for the design of joints, including the surface pretreatment process and adhesive application techniques. This will be followed by assessment of the manufacturing technologies, component assembly methods quality control, and in-service testing. Partners in France and the UK.

## EC Launches Esprit Second Phase

*36980090 Brussels LA LIBRE BELGIQUE in French 9 Nov 87 p 9*

[Article by Paul Dominique: "The European Program For Information Research and Development Enters a New Phase"]

[Excerpt] The fourth Esprit conference just held in Brussels will most certainly be considered a very important turning point in European research.

The goal of this meeting, in which more than 4,000 people participated, was to launch the second phase of Esprit, which will span the years from 1989 to 1993.

**Taking up the gauntlet.** Launched as a pilot phase in 1983 and officially adopted on 28 February 1984 by the Council of Ministers of the European Economic Community, the Esprit program (an English acronym standing for "European Strategic Program for Research and Development in Information Technology") covers a 10-year period divided into two 5-year phases. It is this second phase that has just been adopted.

The aim of this program is twofold: to take up American and Japanese challenges by closing the gap between them and Europe and to encourage cooperation within the Community among industrial enterprises, research centers, and universities. If the second goal seems obvious,

it must be remembered that when Esprit was launched in 1983, Europe's share in global production of electronic equipment had dropped from 32 percent in 1978 to 26 percent, that 8 out of 10 personal computers sold in the Community bore an American label, and that 9 out of 10 video tape recorders were produced in southeast Asia.

Half the financing of projects adopted in the second phase of the program (for a total of 1.6 billion ECUs, or more than 105 billion Belgian francs) is provided by the Community budget and half by the participants.

For the second phase of Esprit, (which will begin 30 November 1988) it is interesting to stress that the Community peogram will be open to the countries of the European Free Trade Association(EFTA).

**A success.**At first, the projects encompassed by Esprit were without exception a matter of pure research at the precompetitive stage and involved five well-defined technical fields: leading edge microelectronics, software technology, office automation systems, computer-integrated manufacturing, and advanced information processing.

The stunning success of the formula is a matter of record: some 450 enterprises (a good half from the P.M.E. [General Confederation of Small and Medium Enterprises]), universities, and European research institutes worked together to bring 220 joint projects to a successful conclusion; in total, more than 2,900 participants. It can thus be said that Esprit made a big breakthrough in the "technological nationalism" that so harmed the old continent.

The Commission seeks to do even better with Esprit 2, albeit with a slight change in direction, by mobilizing 5,500 researchers in 1990. Three years of transeuropean cooperation and a series of concrete industrial spin-offs for the Community's industry (efficient software aimed at accelerating industrial automation, components for computer chips in the telecommunications sector, common technical standards, etc.) will allow the industries to orient themselves more toward the world market.

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## EC's DG XII Director Fasella on Community R&D

*3698A105 Paris LA LETTRE EUROPEENNE DU PROGRES TECHNIQUE in French*
*24 Nov 87 pp 11-12*

[Article by Paolo M. Fasella, director general of DG XII (Science, Research, and Development): "The EC Framework Program and European Research"]

[Text] The most recent meeting of the Council of Ministers, held on 28 September, officially adopted the Framework Program for technological R&D (1987-1991), which covers all activities planned by the EC in this field for the next 5 years. With this instrument the EC will try to fulfill its specific task of playing the limited but essential role in the EC research effort for which it is best suited.

It has now become clear that Europe can only be successful in research and technology through systematical and purposeful cooperation. Only by pooling its financial resources as well as its considerable intellectual resources, which are often badly used due to wide dispersal, can Europe hope to gain a prominent position worldwide in the extremely economically important research sectors such as data processing, biotechnology, or material technologies.

The EEC, which is the clearest expression and the most powerful instrument of European integration, is a natural and particularly well-suited framework for this cooperation effort. Over the years the EEC's technological R&D activities have constantly grown and diversified. The EC effort is now mainly taking place within the framework of the large "second generation" programs such as ESPRIT [European Strategic Program for Research and Development in Information Technology], BRITE [Basic Research in Industrial Technologies for Europe], EURAM [European Research on Advanced Materials], or the Stimulation Program, which consist of highly integrated research which systematically involves several countries and very often, various disciplines.

The Framework Program (1987-1991) is based on the Single Act, which came into effect on 1 July, granting the EC official authority in the field of technological R&D. Its philosophy is quite simple: Do not transfer most research conducted in Europe to the EC level (which would be pointless), but only those research efforts that, for one reason or another, can be conducted more usefully, economically, or efficiently at the EEC level. Such research fields dealing with problems of an obviously European nature include environmental protection or public health; research which exceeds the financial and human resources of one member state as in controlled thermonuclear fusion; research which contributes to the creation of an internal market by supplying a basis of common standards; and research, which is the most common case, in fields which require maximum use of the vast knowledge and skills existing in Europe. It is obvious that no member state has all skills in every field.

In the context of the whole European scientific and technological cooperation program, the Framework Program (1987-1991) ranks halfway between purely basic research and commercial development. Generally speaking, it covers targeted basic research and precompetitive technological development. Accordingly, it has a mutually complementary relationship with European cooperative programs in purely basic research (CERN [European Center for Nuclear Research], the European

Laboratory for Molecular Biology) and with initiatives aiming at commercial development (Airbus) or the development of market-oriented commodities and services (EUREKA).

It was more than a year before the Framework Program was adopted. It should now be rapidly implemented. While officially adopting the Framework Program, the Council defined its position on three programs awaiting decision: RACE [Research in Advanced Communication Technologies for Europe] in the telecommunications field, the new medical research program primarily focusing on cancer and AIDS, and the "Science and Technology for Development" program covering tropical agriculture and medicine. The EC Commission has already submitted proposals for 10 other new programs: ESPRIT II; the AIM [Advanced Informatics in Medicine], DELTA [Developing European Learning through Technological Advance], and DRIVE [Dedicated Road Safety Systems and Intelligent Vehicles in Europe] programs involving data processing applications in specific sectors; an updated version of the BRITE program and of the program on protection against radiation; the new research program on nuclear fusion; the support plan for major scientific installations of European interest; very recently, the "Science Plan," a follow-up to the Stimulation Program; and the new program of the EEC Reference Bureau on norms and standards.

**[Box, p 12, signed F.G.]**

**Paolo M. Fasella's Conference**

Paolo M. Fasella, director general of DG XII (Science, Research, and Development) of the Commission of the European Communities, was willing to outline the structure of European science and technology at a conference entitled "Role and Support of the Commission of the European Communities: the Novations of the Framework Program."

After confirming that the scientific and technological Europe really does exist—as had already been announced in the title of one of the workshops— Paolo M. Fasella listed the stakes for scientific and technological Europe in terms of challenges to be taken up and problems to be solved. Referring to various sectors to illustrate the complexity and increasing interdependence of the world of science and technology, Paolo M. Fasella demonstrated the need to develop what he calls "systemics," i.e., the art of managing complex interdependent systems.

"The stakes are enormous," explained Paolo M. Fasella. At a time when science is becoming increasingly expensive in terms of manpower and materials, its value increases in many areas, namely the commercial, strategic—in particular military—and social areas as well as at the ethical level.

Paolo M. Fasella sees three major problems Europe must solve and illustrates them with examples:

—the risks of confidentiality which hamper the propagation of discoveries and can slow down development by causing duplication,

—the risks of state control because "discoveries are not made on command,"

—the economic risks.

"We will not go very far without the basic knowledge supplied by fundamental research," he said. Moreover, the economic risks pose the problem of choosing the best moment to launch a product on the market with the risk of it being either insufficiently developed or obsolete.

According to Paolo M. Fasella, "the European answer is precisely to offer a market potential which will allow the research effort to expand." After having mentioned the strengths and weaknesses of European research, Paolo M. Fasella stressed the main criteria the programs must meet on a European level:

—a substantial financial and technological aspect,

—a topic of common interest (e.g., energy or pollution),

—the idea of a result that is exploitable on the European market,

—an answer to a shortcoming at the European level (e.g., the fight against AIDS),

—research linked to a common policy (e.g., standards), and, finally, the development of a scientific and technological cooperation among Europeans.

Summarizing the various principles of the second Framework Program, the DG XII director general highlighted its three main novations: the program on medical science and public health (80 million ECU's), the program on science and technology for development (288 million ECU's), and the study on the valorization of the sea-bed within the "marine resources" program (80 million ECU's). He also mentioned the significant progress made in a number of subjects already mentioned in the former Framework Program (data processing companies, modernization of industrial sectors, biological resources, S&T cooperative structures).

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## EEC's DG XIII Director on Knowledge Based Industries

*3698A093 Luxembourg I'M—INFORMATION MARKET in English Jan-Feb 88 pp 7, 9*

[Interview with Michel Carpentier, director general of the EEC's DG XIII: "Knowledge Based Industries Are Increasingly a Community Priority"; date and place not given]

[Text] Question [Q]: Your responsibilities as Director General of DG XIII comprise both the former Information Technology Task Force at Brussels and the directorates at Luxembourg dealing with Information Market and Innovation. Research on telecoms and IT, hardware, software and information-ware and trans-European encouragement of innovation and ideas now fall within this ambit. How has this worked in practice?

M. Carpentier [MC]: First I would like to congratulate your publication on reaching its fiftieth issue. Euronet was a pioneer in the European information world: it brought single, Europe-wide tariffs and created the basis for a single European information market.

In some ways the directorate general has to face up to European information market problems on a small scale: we have directorates in Brussels and Luxembourg. On top of that we have to keep in constant touch with industrial concerns and government ministries throughout the Community. We know the need for a real European information market!

Officials in the directorate general who work in offices more than 200 km apart are getting to know each other, either through face to face contact, by telephone, telex, telefax, electronic mail, teletex, or through voice contact in teleconferences or videoconferences. With a service that represents European information industry, from the hardware, telecommunications networks through to knowledge based systems, we are obliged to use modern systems to communicate with each other. An increasing synergy is apparent.

[Q:] What are the main tasks for DG XIII now?

[MC:] The directorate general's responsibility is to put forward and carry out activities that will give the Community as a whole the ability to control its own future in all aspects of that vital commodity of our society—information. The whole information cycle—capturing, storing, forwarding, transmitting, applying and marketing information—this process requires a coherent drive and a continuous feedback of manufacturers and users. I mean here, hardware and software producers including networks, knowledge-ware producers, the market for services and the end user or consumer of information.

The technological activities of DG XIII such as ESPRIT and RACE are now well under way. Along with IT and telecoms standards, which are central to our European strategy, I am presently putting a priority on information services, innovation and knowledge based applications. This is increasingly a priority for the Commission and the European Community as a whole.

[Q:] Industrial firms sometimes complain at the heavy bureaucratic procedures of the European Institutions. How can the Commission respond quickly to industrial needs?

[MC:] The Commission does respond quickly. On ESPRIT, for example, we have received five times more proposals than the first-phase funding could cover, yet the programme is well ahead of schedule despite the vast amount of work required to select, coordinate and implement more than 200 sophisticated research projects bringing companies and research institutes together across frontiers for the first time. Community programmes would not be so over- subscribed if they were heavily bureaucratic.

We do not only respond quickly but we take the initiative in meeting industrial needs, for instance in launching the Green Paper on the European telecommunications market; in developing action programmes for new technology in health, education and road safety; in starting a special telecommunications action for regional development; in pushing ahead with electronic translation, and in many other areas. It is largely due to Commission initiatives that European industry can lead the world in the vital area of standardization.

It is simple-minded to confuse administration with bureaucracy. The Commission is a lean organisation—each Commission administrator is responsible for the management of more than 1 million ECU per programme, whereas his counterpart in the most efficient Member State only manages a quarter of that figure. The Commission's job is to remove red tape, not create it—for instance by replacing the 70 or so different customs forms in the Community by a single administrative document. And I can assure you that the speed of response of this directorate general compares favourably with that of any administration operating in similar conditions of complexity.

[Q:] What have been the principal achievements of ESPRIT?

[MC:] Let me quote the "New Scientist" correspondent who covered the 1987 ESPRIT conference: "Judging by the noise and the atmosphere that pervaded last week's conference and exhibition, the one thing that cannot be disputed is that Europe's information technology community has proved it can work together." That is perhaps the principal achievement of ESPRIT I, because the proof that we can work together in high technology now underlies the creation of a European Technology Community of very far-reaching significance.

The facts are that ESPRIT I has focussed the work of some 3,000 high-level researchers on the strategic technology European industry needs for the 1990s and impressive results have already emerged from some 50

of the projects, even though most of them have not yet reached completion. Many of the results were on show for the first time at this autumn's ESPRIT Conference, where more than 50 ESPRIT teams brought demonstrations. Industrial products resulting from ESPRIT work are already coming on to the market.

The 500 or so partners in ESPRIT I represent companies of all sizes, universities and research institutes from all over the Community, who are successfully working together across borders at all levels. The result is a considerable renewal of industrial confidence and technological ambitions, significant progress in strategic technologies and standardisation, and a change in the European IT landscape that is already putting us in a much better position to meet international competition in the 1990s.

[Q:] With Council agreement on the Framework Programme defining the budgetary envelope for EC research and development programmes, the Commission has proposed a whole series of new initiatives: DRIVE in transport systems, AIM in medical informatics, DELTA in distance training and education as well as RACE on broadband telecoms and ESPRIT II. What's behind this spate of programmes?

[MC:] These are carefully-designed programmes—not a "spate"—which make up an overall, coherent, Community strategy aimed at providing the European economy with the necessary means for international competitiveness in advanced sectors with a high technological added value. They are closely allied to the completion of the internal market scheduled for 1992.

European action needs to address both technology and markets. Application programmes such as these are not only designed to bring the benefits of new technology more quickly into everyday life, for example in health care and education, but to accelerate the development of a Europe-wide market—offering major economics of scale for enterprises and greater choice for users—and to stimulate enthusiasm for innovation throughout that market, so that there is a faster take-up of new technology in the Community. Clearly standardisation plays a key role, via these application programmes and throughout our strategy, in creating such a European market.

[Q:] The Commission has also proposed a more modest action plan for 1989-90 to stimulate a really European information services market. Given that companies spend 10 to 100 times more money on the down market side than research, shouldn't more attention be given to creating European services and professional user groups?

[MC:] We're talking here more about knowledge based systems. These are yet a further development of the IT revolution. Databases have been with us for some time, but the market for individual professional information systems is still in its infancy. Certain sectors have of course developed more rapidly than others, the financial one, for example.

Other professional areas are just realising what the equivalent European or world economy of scale could bring as advantage. Some of these developments will depend on getting the right networks, hardware and software in place, before the information systems (or information-ware) can be properly exploited.

The recent Call for Declarations of Interest has given us a good indication on the huge potential for these markets. In the past when we have made a Call for proposals for new databases or advanced information systems we have received a greater number than we could respond to—perhaps 150 proposals. This time we asked for large scale demonstration projects that would indicate the potential of the single European market. So far we have received nearly 700 proposals and the officials concerned tell me that a large proportion of these are of very high quality.

We have obviously released a creative torrent of industrial applications. We will do our best to respond to them with the resources at our disposal. The first projects could be selected by early next year.

**[Box, p 7]**

**Directorate General XIII Telecommunications, Information Industries and Innovation**

Staff Plan

Director General: Michel Carpentier

Deputy Director General with special responsibility for directorates B and C: Vicente Parajon Collada

Directorate A: Information technology—ESPRIT: Jean-Marie Cadiou

Directorate B: Information industry and market: Cornelis Jansen Van Roosendaal

Directorate C: Exploitation of research and technological development, technology transfer and innovation: Albert Strub

Directorate D: Telecommunications: Tjekko Schuringa

Directorate E: Support for sectorial activities: Michael Hardy.

## Netherlands Science Policy Advisory Council

*3698A101a Zoetermeer SCIENCE POLICY IN THE NETHERLANDS in English Sep 87 pp 6-8*

[Article by Alette Warringa: "It Is Time for a Different Structure—RAWB Plea for New Council of Both Science and Technology Policy"]

[Text] Dr H.G. van Bueren, the chairman of the Science Policy Advisory Council (RAWB) leant back in his chair thoughtfully. 'The Council sees it like this. For twenty years we have tried to create a streamlined, nationally coordinated science policy and put some of our best people to work on it. But it doesn't work.'

'Ministers are responsible for their own policies but not for those of others; thus they can scarcely be bothered to listen when another ministry gets involved with their research effort. It is time for a different structure.' Last month the RAWB submitted its annual report to Mr W.J. Deetman, the Minister of Education and Science, containing its views on science policy and its future. The minister had asked the Council to concentrate in this report on the next four years, i.e., beyond the life of the present government, and to indicate the necessary tasks and instruments. The report has gone much further, however, and sketches a whole new structure for Dutch science and technology policy, with a network of advisory bodies. The press called it a bid for power as the new RAWB, which would also advise on technology policy, would have a crucial role as advisor to the government.

### Government

Science policy is the joint responsibility of all the ministries, the Council says. The government should therefore shoulder this responsibility directly and the main policy issues should come together under the auspices of all the ministers jointly. Each ministry should be responsible for research in its own area of policy but the council says there should be a new fund of 100 to 200 million guilders to promote research involving more than one ministry or to start up new research. Government decisions on science policy are prepared by a civil-service body, the Interministerial Consultative Committee on Science Policy (IOW). The RAWB says that this Committee should have greater authority and that its recommendations to the RWT (the cabinet committee on science and technology policy) should be clearer. The IOW is the forum for the research coordinators of the various ministries. If the ministries had full responsibility for their own research, as the RAWB proposes, these coordinators would draw up the research policy of each ministry—at least in general terms and under the auspices of the minister concerned. Funding bodies 'at arm's length from the government' would have to provide further details and arrange the flow of funds to the research institutes.

### Sector Councils

Advisory councils, consisting of researchers and clients, should indicate to the coordinators the direction overall policy should take. These councils would ensure proper contact with interested parties within the community, for example local government, interest groups and the private sector. 'Research should not take place just because the government wants it but also because the clients do,' commented Dr Van Bueren. The advisory councils should enable clients to make themselves heard.

These advisory councils are very much in line with the Sector Councils Framework Act, which was passed by parliament in May. Sector councils have existed for years but this act has given them legal status. They report on specific sectors (areas of concern to society) to ministers and consist of researchers, government representatives and research 'users.' There are sector councils for environmental research, agriculture, health research, town and country planning, housing and construction and development cooperation. The new act makes it easier to form new councils. The ideal would be for each area of ministerial responsibility to have its own sector council, the RAWB feels. The new law has thus come just at the right time for the RAWB.

The Council's objectives include good staff and greater effectiveness. But this does not mean that all research efforts should be constructed from the top down—on the contrary. The main features will have to be set out, the council says, but the contribution of the researchers themselves is more important.

The RAWB disagrees with the Dekker Committee, which wants to make university research subordinate to the wishes of the private sector. The universities are centres for unrestricted fundamental research and for training 'good staff' (i.e., good scientists), says the report. 'If they were to concentrate solely on the economic market, such spontaneous scientific research would be irretrievable lost. In addition technological research would receive a disproportionate amount of attention,' Dr Van Bueren added.

The RAWB wants to give research establishments, particularly the universities, more opportunities to make their research more creative and more effective. Institutes for applied research and technological research establishments should retain a margin of some 20 percent for their own fundamental research.

University research and management should be kept separate so that university researchers would be freed from the enormous burden of administrative work and in order to enable the quality of research to be monitored. 'Audits' by external scientists and more contacts with foreign researchers could further increase the effectiveness of research.

Dr Van Bueren went a step further and suggested that science as a whole could not be administered by a nonscientific body. 'I don't think that you can plant any idea on a scientist. If you want good work you have to enable researchers to generate their own ideas and only later, as a policy official, say whether it can be taken further or not. That is permissible but it doesn't work the other way round. Take, for example, the increase of CO2 in the atmosphere. Government has repeatedly called on scientists to do something about it but scientists are not interested or can't come up with a solution. So the government gets nowhere and the problem has not gone away.'

**Piecemeal**

Does Dr Van Bueren think that the notoriously piecemeal nature of the country's science policy can be changed by the structure proposed by the Council?

'No, not at all' he answered. 'On the contrary, the distribution of responsibility among the various ministries means an even more piecemeal structure. But that is simply the way things are; it is inevitable. A streamlined scientific world is not possible. You can structure transport, development cooperation, even trade to a certain extent, but science can no more be structured than art.

We want to raise science policy, insofar as it affects supraministerial matters, above the separate ministries in the hope that each ministry's interests will play at less significant role in the IOW. Because of the piecemeal approach you don't hear suggestions of doing things together in the IOW.' We asked Dr Van Bueren whether he was not afraid that the interests of the individual ministries, which the Council says have constantly frustrated a national science policy, will reappear in the RWT or the government. 'We shall have to see if there is an improvement,' he admits. 'In any case the Council considers that it goes without saying that authority for decisions on science and technology policy should lie with the government.' What will happen when controversial problems emerge in which the interests of the various ministries are in conflict? A powerful group of users, the private sector, could be harmed by a stricter environmental policy, for example, but this could eventually become necessary. 'Environmental problems will have to be tackled by the Ministry of Housing, Physical Planning and the Environment,' says Dr Van Bueren. 'They will give them priority. If they don't, the cabinet naturally will not be able to discuss the matter. Whether this problem should outweigh the interests of industry—or whether there are better ways of dealing with it—must be decided by cabinet. We must find some way of avoiding a situation in which one ministry dominates decisions that affect all government departments.'

**Science and Technology Policy**

In order to avoid internecine warfare the Council thinks that there should be an independent advisory council for the government to maintain an overview. This council would have to concern itself with the whole of research policy, including technology policy. The RAWB does not support the Dekker Committee's proposal for a new advisory council on technology policy. This would stress the division between science and technology policy, which the RAWB deprecates. 'Science and technology policies should never have gone to separate ministries!' Dr Van Bueren exclaimed. 'The fact that it happened was the first sign of decay. You than had one ministry, Economic Affairs, taking over technology and defending its own interests in that area, and another ministry, Education and Science, that had all the rest but had lost contact with technology policy. That was a disaster. Technology can only grow if there is contact with other sciences, for instance biology or medicine, and conversely, technology helps them to grow. Contact must be resumed!'

A year ago the minister of Education and Science, Wim Deetman, warned in this journal of the dangers of a split between science and technology. The minister noted, however, that these problems had been neatly avoided in the previous four years as there was close cooperation with Economic Affairs. To combat a piecemeal approach to various technological research activities the minister envisaged the establishment of a technology institute, for which the recently installed Dekker Committee was to make proposals. The structure now proposed by the RAWB leaves technology policy with the Ministry of Economic Affairs, scientific research with the Ministry of Education and Science and the other areas of research with the various ministries. But will it be possible to bridge the gaps that have arisen?

Yes, and that is why it is important for the government to have an independent body that can advise on both science and technology policy,' said Dr Van Bueren. 'The RAWB on its own is too small for this. We need a new, large body which should consist of people with experience and knowledge about long-term developments in science, technology, health, demography, climate—politics too—and who can say which direction the Netherlands should take in the future. Something like the Advisory Council on Government Policy, which acts in a similar capacity for other areas of policy.'

One cannot say whether such a 'super' council will be set up and, if so, whether it will have the influence Dr Van Bueren imagines. 'I don't know. It would have to grow. We may have to be satisfied with a more primitive approach. But it is worth a try.' There will be more clarity about the future of science policy in a few months, when Mr Deetman will be submitting to parliament a new policy document on science policy, containing new perspectives. No one doubts that science policy must strike out in new directions but it is too early to say which path it will take. The RAWB's report and the Dekker Committee's report together provide enough material for an interesting discussion.

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## SUPERCONDUCTIVITY

### Rhone-Poulenc World Leader in Rare Earths, Superconducting Powders

*3698A074 Paris L'USINE NOUVELLE in French 22 Oct 87 pp 8-9*

[Article by Philippe Lanone, Alain Dieul, and Michel Vilnat: "From Powder to Chips"]

[Excerpts] Will the superconductor market be a $1- or $10-billion market? The analysts toss fabulous figures around, but it is the development of the various applications which will determine the answer. Whichever segment of the market experiences the strongest expansion, there is one certainty: It will carry along in its wake the development of the superconducting powders, an area in which France is particularly well placed. Moreover, the leading national firm, Rhone-Poulenc, has already made investments in this area.

The production of superconducting powders, though still upstream of component manufacturing, is a field whose technology has been mastered. The manufacturers of fine ceramics have experience producing similar powders with a high degree of purity. The top French firms, Pechiney and Rhone-Poulenc, are already marketing superconducting powders. Pechiney is firmly entrenched in the ceramic powders field through its subsidiary, Criceram, which is part of the group's advanced materials branch.

Still, it is Rhone-Poulenc which seems to have the greatest advance in the superconductor field today. Aside from ceramic powder technology, the French chemicals firm enjoys privileged access to the raw materials for these products. Until now the superconducting materials in question employed essentially two elements, lanthanum and yttrium, in association with barium and copper. Lanthanum and yttrium are part of the 17 natural elements that make up the rare earths group, a field in which Rhone-Poulenc is the world leader. It controls 40 percent of the world market in separated rare earths with a substantial lead over its major rival, the U.S. firm Molycorp, which has only 20 percent of the market. The other competitors are mainly Japanese and their cumulative production represents about 24 percent of the world market.

Rhone-Poulenc production is split between its La Rochelle plant and, since 1980, its plant in Freeport, Texas. Currently, production is being beefed up in Southeast Asia with the launch last year of Nippon Rare Earth, a joint venture with Sumitomo Mining, and with the construction in Australia of a separation unit which is to begin work early in 1989. An even more telling point: Rhone-Poulenc is equally well placed for access to monazite, the mineral which constitutes the main source of rare earths. At the start of the year Jean-Rene Fourtou's group signed a long-term contract for the supply of all of Australia's Associated Minerals Consolidated's monazite production, and last year it bought the U.S. Mineville's yttrium-rich spoil heaps.

There is only one problem. No one can say that only rare earths will continue to be used to produce superconducting alloys. However, of now the stakes justify the investments. Two research teams are working in this area at Rhone-Poulenc—one in France, the other in New Jersey with a staff of three. "In all," explains James Spooner, director of new activities at Rhone-Poulenc Inc., "this year we are going to invest between $2 million and $4 million in superconductivity research."

Normally, electric machine manufacturers buy their copper or aluminum cables. In the case of superconducting ceramics, they will order the basic materials in powder form and will manufacture the wires themselves, following the example of Alsthom at its Belfort plant. These superconducting ceramics of the perovskites family, with a base of lanthanum, yttrium, barium, and copper oxide (YBaCuO), do not lend themselves readily to wire drawing because they are in powder form, which poses certain mechanical as well as chemical problems.

The method presently used is to fill a hollow silver wire with the powder and then to sinter. As this is a hot process, the powder would lose too much oxygen and at the same time its properties. The operation must thus be carried out in an oxydizing atmosphere to prevent the escape of gases.

Such an operation is delicate and it is quite difficult to control the homogeneity of the powder, not to mention the fact that the mechanical resistance of the silver is not good.

Other methods are also being tested. One such method consists of depositing a thin film of basic materials on a metal tape by vacuum evaporation with oxygen present. Other approaches have also been tried, such as ceramic plating [projection de ceramique] on a stainless steel tape. In that case, too, it is difficult to control the homogeneity of the resulting structure.

For now, this work relates only to direct current. The production of niobium- titanium wires (the most common superconducting alloy) conducting 50 Hz is extremely complex. At this time only Alsthom possesses this industrial expertise; it involves repeated extrusion alternating with complex thermal treatments. Such a conductor, listed under code CCN 14000 LL, has a diameter of 0.12 mm and is made up of 14,496 filaments 0.55 micron in diameter.

The Marcoussis team has even succeeded in producing a wire 0.08 mm in diameter with 254,100 niobium-titanium filaments. Each filament, 800 angstroms in diameter, is covered in cupronickel. The whole is then twisted to reduce electromagnetic disturbances. For the present,

mass production poses substantial problems. Researchers are actively pursuing this area, however, especially toward direct wire drawing from ceramics.

In microelectronics the use of superconducting materials is based primarily on the mastery of thin film technology, i.e., deposits of a thinness on the order of 1 millionth of 1 millimeter!

The laboratories working on gallium arsenide (GaAs) are already equipped with extremely expensive machines with such precision. The LETI (Laboratory for Electronics, Technology, and Instrumentation) in Grenoble is placing great hope in vacuum sputtering. This technology involves creating a plasma of ions with which the target consisting of superconducting materials is bombarded, thus extracting the precious atoms which, after crossing through a mask, are deposited onto the integrated circuit being produced.

Currently, the substrates are heated to 900 degrees Celsius, a temperature too high to obtain thin films of sufficient quality. "The method we are developing will make it possible to get down to 600 or even 500 degrees Celsius. It appears promising to us because it is easier to mass produce," explains Jean-Claude Villegier, chief of superconductor research at LETI.

The researchers at CNET (National Center for Telecommunications Studies) in Bagneux are studying a similar method and conduct parallel research using molecular jet epitaxy equipment. In a vacuum of about 10 atmospheres, i.e., 1,000 times higher than on the surface of the moon, this machine simultaneously evaporates the basic elements constituting the superconductor. By controlling the evaporation speeds separately, the layers differ in composition and thus present different properties—an ideal research tool.

Although all such equipment is in essence already available, there remains a tremendous investment to be made in brain power. The road to master one of these technologies and obtain consistent results will be a long one.

Before the arrival of such thin-film electronic components, we may well see ceramic substrates on which one or more GaAs components are linked by superconducting paths. It would be a sort of printed circuit which would shorten transit times between chips. Prototypes are reported to be already undergoing testing in IBM laboratories.

25050

## French Developing Superconducting Wires, Transformers, Alternators

*3698A073 Paris L'USINE NOUVELLE in French 22 Oct 87 pp 4-7*

[Article by Alain Dieul and Michel Vilnat: "Superpromises of the Superconductors"]

[Excerpts] Today, thanks to the collaboration of Marcoussis researchers and Alsthom engineers in Belfort, the French are the first to produce superconducting wire that operates on 50 Hz. It is a fair bet that the Japanese will soon succeed in equaling the feat. A new era in electrical engineering is opening up to industry. The key is to be able to mass produce the wire! A first superconducting transformer has already been produced. Its mass is 13 times smaller than that of a conventional one of the same power. This week another transformer of the same weight will be tested. Its performance is expected to be three times better.

As specialists point out, however, for energy production to be efficient all the elements of the production process must be superconducting, starting with the alternator. As part of a program with EDF (French Electricity Company), Alsthom has developed an operational 250-MW prototype alternator with a cryogenic rotor. It is estimated that a 1,000-MW machine should be 20 percent less expensive than conventional systems. A fully cryogenic transformer (rotor and stator) would save another 30 percent. That is an impressive market considering that EDF's requirements for the next 20 years are estimated at 80,000 MW. According to the most pessimistic estimates, that would correspond to a budget of Fr 4 billion. As for the prospective use of the new superconductors operating on nitrogen, the treshold of economic use would start at 30 MW! However, researchers are not yet able to produce "warm" wire.

There are two other areas still more eager for superconducting devices— armaments and space. According to Japanese observers, the Soviet Navy is reported to be testing cryogenic propulsion units for their submarines. The U.S. military is reported to be considering installing superconducting alternators on its aircraft. Their weight-/power ratio (50 g/kw) will be 10 times higher than that of a nuclear power plant alternator. They could provide the energy required for on-board lasers.

The area of choice for such engines, however, will be space. And if the U.S. Star Wars program is implemented, the opportunities will be made to order. In Earth's orbit the outside temperature of a body not exposed to the sun corresponds approximately to that of superconducting ceramics. This is not science fiction: The Parvex company of the Alsthom group has already built a prototype of an engine that can be installed on board a satellite. It will monitor the movements of a telescope.

[Box, p 6: Excerpted interview with Pierre Aigrain, scientific adviser to the chairman of Thomson, by Marc Chabreuil; date and place not given]

### The First Electronic System in 3 Years

Pierre Aigrain, former minister of research, has served as scientific adviser to the chairman of Thomson since 1982. A physicist specializing in semiconductors, he set up the physics laboratory of the Ecole Normale Superieure in 1948 which he led for 20 years. During that period one of his teams worked on...granular superconductors.

L'USINE NOUVELLE [UN]: Do you think that French laboratories can keep up with American or Japanese research teams?

Pierre Aigrain [PA]: Yes, provided the government, industry, and the universities shift into third gear. Without, however, abandoning silicon, GaAs, etc., because superconductivity has suffered too much from the stop and go policy of modishness prevalent everywhere. We cannot allow the momentum to drop off in 3 years, which is what happened with the first superconductors and then with the Josephson effect.

French industry, CGE-Alsthom and Thomson in particular, was the first to make substantial efforts in this area. Just as in the case of IBM, the most advanced U.S. company, we have called upon in-house capability by mobilizing and bringing together our specialists in ceramics, thin films, etc.

This research requires expensive equipment such as molecular jet epitaxy facilities. However, our public laboratories are relatively poorly equipped. We must admit that materials research was not considered by either French scientists or scientists outside France as a worthy endeavor. It was not sexy enough! Often they were satisfied with conducting "xerox research," as my friend Hubert Curien calls it: We reproduce what has already been done elsewhere, adding certain minor changes. This sometimes results in substantial progress. The Japanese are very strong in this type of systematic research which requires little imagination. However, they are not ahead of us.

[UN] What place does Thomson occupy in the field of superconducting electronic components?

[PA] The equivalent of 10 researchers is working full-time on superconductivity at the main research laboratory today. In 1988 there will be about 20. In addition some division people are already considering possible applications. We can consider development of high-cost-per-square- centimeter technologies if a single component can revolutionize the performance of a complex system.

25050

## TECHNOLOGY TRANSFER

### Effect of COCOM Regulations on EC; France Sets Up Export Rules Database

*3698A092 Paris OBSERVATOIRE DES TECHNOLOGIES STRATEGIQUES in French Nov 87 pp 6-7*

[Article by R. Lavergne in cooperation with Pierre Dournel (DGI [General Directorate of Industry]/SEC—subdirectorate of bilateral affairs) and Michel Aguilar (DGI/SERICS—international mission): "COCOM ('Coordinating Committee on Multilateral Exports Control')"; all quotation marks as provided by source]

[Text] Subject: COCOM and the regulations established by this organization were mentioned in several recent transactions concerning technology transfers; many small- and medium-sized companies are unaware of its role and may experience export restrictions or delays in their commercial operations.

#### 1. COCOM Operation

The Coordinating Committee on Multilateral Exports Control, or COCOM, was created in 1949. It has 16 member countries (Japan and all NATO members but Iceland) and several countries "cooperate" (Ireland, Switzerland, Yugoslavia, Austria, Hong Kong, and Finland, as regards France). It is a "multilateral confidential organization based on an informal agreement." Its task is to coordinate export controls, and it is up to each member country to put these controls into effect at the national level. It meets in Paris and prepares a periodically updated "list" of sensitive products and strategic technologies which may help strengthen the military potential of the countries "affected by the controls" and to which the member countries are not permitted to sell without the committee's consent. This list is the same for all the member countries; for France, it is published in the JOURNAL OFFICIEL in the form of "directives": About a hundred products considered to be sensitive (data processing, electronics, components, measuring instruments, metalworking, rubber, etc.) are declared subject to the "control of the final destination."

When a French company wishes to export a product on the "list" to a COCOM member country or cooperating country, it must first obtain, based on the advice of the technical ministry concerned, an "export license" from Safico, the specialized department of the French customs service. For some products and destinations an "international import certificate" (CII) and a "delivery verification certificate" (CVL) must be obtained by the company's client from the agencies concerned (ministries, chambers of commerce, etc.) of the destination country.

Cases of exports to countries "affected by the controls" are theoretically submitted to a COCOM examination in Paris by the representative of the country concerned. Member countries are not forbidden from establishing a larger list than the official "list"; for instance, on President Reagan's impetus, the United States put into effect a very long list which is unpublished and which defines different geographical areas than those defined by COCOM.

Sanctions against companies who violate COCOM rules intentionally or unintentionally are the responsibility of the countries in which these companies are located. The sanctions may be fines, even prison terms, or complete or partial prohibition to export to the countries "affected by the controls." Nevertheless, the United States also reserves the right to apply sanctions against guilty non-U.S. companies, as it has recently threatened to do to Toshiba, with a prohibition on importing many of the group's products to the United States as well as a cancellation of orders already placed.

**2. Some Disputed Points**

Wisse Dekker, the chairman of the Philips supervisory board, underlined recently (LE MONDE 31 October 1987) that the regulations established unilaterally by the United States come close to a permanent threat on export markets when parts (in particular, components) of American origin are used in the products affected. Furthermore, the DOC (Department of Commerce) realizes that this could prove disadvantageous to American exporters and has suggested a liberalization of these rules, but the DOD (Department of Defense) continues to oppose this. Too often, however, this system appears to be using COCOM as pretext to favor the companies of one country and to cause market loss among competitors.

Moreover, the "sensitive" nature of a product or technology is often difficult to evaluate, and quite often, small- and medium-sized companies do not know that their products may have military applications.

The difficulties are lessened for the large companies, such as Philips, to the extent that this factor can be included in major commercial negotiations. But fraudulent deals, which the media have been reporting lately, are always possible and introduce factors of disloyal competition. Greater clarity of the COCOM regulations and the associated rules adopted by the member countries thus would undoubtedly be desirable.

For France, a database called INFOCOM is being set up at the Ministry of Industry, Post and Telecommunications, and Tourism (SERICS, M. Aguilar, tel.: (1) 45.72.84.01). Its goals are to inform export companies, especially small- and medium-sized companies, about the French export procedures applicable to the product concerned (export licenses, distribution licenses, administrative exceptions, etc.), and to help them examine the "sensitivity" of their products with respect to the final destination control. This database should be available in 1988 and accessible through Minitel.

25053

## AEROSPACE, CIVIL AVIATION

### Lack of Coordination Impedes Brazilian Space Program

*36990043b Rio de Janeiro O GLOBO in Portuguese 10 Jan 88 p 12*

[Text]Sao Jose Dos Campos, SP—Personal differences, short-term economic interests, disagreements among responsible researchers, financial difficulties, differences of opinion. These are some of the characteristics of the industrial and research operations that have been causing problems in the development of the Brazilian space program as well as giving rise to overlapping efforts, despite the economic crisis, or delay in some projects and even waste of public and private resources.

One of the clearest examples is the development of solid fuels and raw materials for their manufacture, which are made in at least two different institutions, the Institute of Space Activities (IAE), the organ of the Ministry of Aeronautics linked to the Aerospace Technical Center (CTA), and the Research Department of Avibras Aeroespacial.

The dispute over the country's solid fuels started on 18 December, when the IAE carried out the first test of one of the engines of the satellite launching vehicle (VLS) and announced that this was the first instance of using a rocket fuel that was made entirely in Brazil.

The management of Avibras said that these facts were untrue. According to the company, the fuel technically known as "composite" was developed by the company in 1962, just 1 year after the company had been formed. Also, according to Avibras, the materials in the fuel were already produced in Brazil by Petroflex and by Avibras itself, in a unit that has been operating in Lorena, in the Paraiba Valley, since 1984.

The company believes that there is wasted effort and unnecessary spending occurring in the CTA's solid fuel projects and it is willing to supply the fuels. The offer, in the meantime, does not seem to have aroused any interest. The CTA acknowledges that there has been some overlapping effort, but it prefers to believe that losses and waste, if any, have not occurred with relation to the public resources utilized in IAE's research activities.

In 1982, the CTA received an inquiry from Avibras, which was interested in receiving the technology for production of ammonia perchlorate, a substance obtained from electrolysis of salt. The negotiations did not go forward and Avibras decided to set up its own research group to obtain the raw material, which was imported from the United States and Japan.

The development of the perchlorate cost Avibras 2 million dollars plus 4.5 million dollars as the cost of installing the plant. The firm is now entering its first export contract, because it has a surplus. The CTA itself benefits from this: in June, it needed 5 tons of ammonia perchlorate for a rocket-engine test and it borrowed the material from Avibras.

Within the CTA, however, it is said that the material from Avibras cannot be used because it does not meet specifications. Several specialized publications, in the meantime, acknowledge that the Brazilian firm is a worldwide pioneer in loading solid fuel in rockets exceeding 70 millimeters in caliber.

The lack of coordination of research with industry has given rise to innumerable problems for the Brazilian space program, even though there have been several successes. Somehow, these difficulties can be overcome by means of negotiation that is now getting started concerning one product that is another example of overlapping efforts: the CTA wants an inertial platform, a kind of automatic pilot for rockets, which Avibras has just finished developing and has already been utilizing in some products.

13331

## BIOTECHBOLOGY

### Brazil Aids R&D in Biotechnology in Santa Catarina

*36990043c Brasilia BRASIL CIENCIA in Portuguese Nov 87 p 7*

[Text] Last weekend in Joinville, Minister Luiz Henrique signed some 5 agreements with the government of Santa Catarina, which will create the Santa Catarina Biotechnology Development Center. The center, planned by the State government's Department of Science and Technology, will investigate the processes of fermentation to develop secondary metabolisms, amino acids, and vitamins needed in the food and drug industry. The initial outlays will be on the order of 4 million dollars, of which 2 million will be for the National Scientific and Technological Development Council (CNPq), a part of the Ministry of Science and Technology (MCT), 1 million for the State of Santa Catarina, and 1 million for the private sector.

The 5 agreements between the MCT and the State of Santa Catarina were: an agreement for the Department of Biotechnology of the MCT to draw up a physical design for the center; a 2 million dollar agreement with the CNPq for procurement of machinery and equipment; a letter of agreement with FINEP for financing of up to 2 million dollars for the projects; an agreement with the government of West Germany for a 2 million dollar technical assistance and project financing loan; and an agreement with the State of Santa Catarina and local businesses to devote 2 million dollars (1 million

each) to construction of a building for the Santa Catarina Biotechnology Development Center. Altogether, these 5 agreements will result in the expenditure of a little over 8 million dollars.

The importance of these agreements for the socio-economic development of Santa Catarina can be measured by the fact that biotechnology is still not highly developed in the State. But it is worth noting that Santa Catarina possesses a considerable amount of electrical and metallurgical industry which emphasizes production of motors and compressors. This industrial base is considered to be fundamental to the center project, since these firms will go on to manufacture reactors, bioreactors, fermenters, and other equipment and accessories needed for expansion of biotechnology in the State.

The Santa Catarina Biotechnology Development Center will be developed in two stages:

1) Construction and operation of the equipment (reactors, bioreactors, and fermenters).

2) Applications:

— Products highly utilized in the State, such as agricultural products for poultry farming, feed, etc., which are currently being imported and which consume foreign currency.

— Secondary metabolisms based on plants. This is the area, which is underdeveloped in Brazil, which interests the government of West Germany. Thus, the 2 countries will jointly study the pharmaceutical use of Brazilian plants and will have the rights to utilize the products that may result.

13331

## DEFENSE INDUSTRIES

### Brazil To Use Indigenous Air-to-Air Rockets on AMX

*36990047d Sao Paulo O ESTADO DE SAO PAULO in Portuguese 7 Jan 88 p 2*

[Text] Brasilia—Within 30 days, the Ministry of Aeronautics will sign a contract for the purchase of MOL-1 air-to-air missiles, manufactured by the Sao Paulo firm, Orbita, for use on "Mirage III" and F-SE fighter and bomber aircraft, as well as on the future AM-X's, which will start to be delivered to the FAB [Brazilian Air Force] by EMBRAER [Brazilian Aeronautics Company] this year. The purchase of indigenous missiles is part of the program for nationalization and self-sufficiency initiated during the past 10 years by the Brazilian Air Force.

The Brazilian air-to-air missile is provided with an infrared sensor to track the turbine of the enemy plane and destroy it, through the activation of a sensor with computerized approach. It is part of a family of missiles beginning with the U.S. "Sidewinder," and modernized by all the nations of the world, such as Great Britain, Italy, the Soviet Union, and China.

The Brazilian project was developed by the Aerospace Technology Center (CTA) in Sao Jose dos Campos (SP), and later turned over to the Sao Paulo firm of D.F. Vasconcellos, which was responsible for completing the missile and starting its manufacture on a commercial scale. However, the company suffered serious economic problems and the missile was transferred to the Orbita company, created with capital from ENGESA [Specialized Engineers, Inc.], producer of armored vehicles, such as the "Cascavel" and "Osorio,"and from EMBRAER (manufacturer of the "Brasilia," "Tucano," and AMX aircraft), as well as with another small percentage of private capital.

According to unofficial reports from the Ministry of Aeronautics, the initial contract is assessed at $40 million. That first shipment is planned to equip the entire F-5E fleet with approximately 26 airplanes, all "Mirage III," currently numbering 15 aircraft, and the 79 AM-X's. Hence, it is possible that from 250 to 300 units of this missile will be purchased at the outset.

Moreover, as part of the Brazilian strategy of never limiting a product to the domestic market, the missile is due to be offered for sale on the international market. At present, the Soviet Union, Communist China, the United States, and the nations of the European Economic Community are the only ones that have sold abroad this type of missile which equips airplanes and helicopters with antiaircraft batteries.

2909

## MICROELECTRONICS

### Brazil Develops Titanium Silicide Semiconductor Technology

#### Research at Sao Paulo University

*36990047c Sao Paulo O ESTADO DE SAO PAULO in Portuguese 5 Jan 88 p 3*

[Text] Brazil now has the technology to produce the most modern products for integrated circuit interconnection: titanium silicides. The research to develop that material has been conducted since 1985 by the Materials and Processes Division of Sao Paulo University's Integrated Systems Laboratory (LSI). That process is currently at the disposal of the computer firms interested in investing in titanium silicides, which are now being used in integrated circuits with 1 and 4 Mbits of memory, produced in the United States, Japan, and Europe.

Prof Dr Jacobus W. Swart, coordinator of the Materials and Processes Division, explains: "Because they have an electrical resistance 10 to 20 times less than that of

traditional interconnection materials, such as polycrystalline silicon, the silicides reduce the signal propagation time and make the circuit more rapid." He claims that the use of this material also makes it possible to reduce the total area occupied by the interconnection lines, decreasing the size of the chips. This is possible because silicide is refractory and can be oxidized, allowing for the use of interconnection on various levels. In other words, they can be placed on top of one another, and separated by an insulating layer.

2909

### Commercial Firms To Conduct R&D, Market Products

*36990047b Sao Paulo O ESTADO DE SAO PAULO in Portuguese 9 Jan 88 p 1*

[Excerpt] Within approximately 4 years Brazil will be joining the exclusive club of metallic titanium producing countries, of which, in the Western bloc, only the United States, Japan, France, and Great Britain are currently members. This will take place through a likely association between the Itabira Special Steels Company (Acesita) and Electrometal,Inc, which will process the titanium sponge to be produced by an also potential association between the Rio Doce Valley Company (CVRD) and Andrade Gutierrez Construction, using technology currently being developed by the Ministry of Industry and Commerce's Secretariat of Industrial Technology (STI) and the Aerospace Technology Center (CTA).

This disclosure was made yesterday by the president of Acesita, Mauricio Hasenclever, explaining that the initial plan is for an industrial plant to produce 1,000 tons of metallic titanium plates per year, representing billing of $40 million, based on the fact that a kilogram of the product is currently priced at $40. This is the price that Brazil is currently paying for the 300 tons per year that it imports for use in the chemical, oil, and aerospace (EMBRAER [Brazilian Aeronautics Company] industries; anticipating a minimal increase in demand totaling 5 percent annually, owing to its high degreee of durability, resistance to corrosion, and lightness.

Mauricio Hasenclever gave a reminder that, in Tapira, in the Minas Triangle, 70 percent of the world reserves of anatasium, one of the ores from which titanium is extracted, and currently the most abundant, are concentrated. CVRD has already established a pilot plant in the area to produce anatasium concentrate, with a planned production of 300,000 tons per year for the initial supply to a project already approved, based on an association between Andrade Gutierrez and Dupont, for the future production of titanium pigment, used to produce special dyes. There are agreements for the same construction firm, in association with CVRD, to participate in another project to produce titanium sponge, in the technology of which alone STI has already invested nearly $20 million.

CTA has already produced a certain amount of titanium sponge (the principal phase in the procurement of metallic titanium) on a laboratory scale; while STI, concurrently with other research in the field, has converted it into metallic titanium and, based on an agreement, in Acesita's rolling mills, has procured two plates, currently being subjected to tests by the organization.

The Acesita president explained that there is technology available for metallic sponge production from American firms, but that it is alreadyobsolete in comparison with Japanese technology, which is not available for transfer. During the 1960's, the United States invested $250 million in lost funding for the development of the technology, which is for sale, but which is not compensatory, because it produces a more expensive metallic titanium that has little international competitivestatus now. Mauricio Hasenclever thinks that the metallic titanium to be produced in Brazil will be even cheaper than the Japanese.

2909

## NUCLEAR DEVELOPMENTS

### Brazil Establishes International Patents Data Base

*36990047a Brasilia INFORMATIVO IBCT in Portuguese Nov 87 p 3*

[Text] BPATENTE is a data base of the National Commission for Nuclear Energy's (CNEN) Nuclear Information Center (CIN) which contains patents of interest to the nuclear and related fields, intended to meet the requirements for information to keep track of patents deposited in the National Institute of Industrial Property (INPI).

They were stored in the patent base as early as 1983, and the search had to be extended to previous years, starting in 1970. The INPI Journal of Industrial Property was used as a reference source.

Two files can now be consulted:

— Materials (containing Brazilian and foreign patents deposited in Brazil, citing the respective status of the official process, that is, the status in INPI);

— Equipment (for the time being, this file contains only patents on detectors and sensors).

BPATENTE's services may be used by contacting the CIN Information Analysis Group. The user may submit his request using postal services, courier pouch, telephone, or telex.

Address for further information:

CIN/CNEN 90 General Severiano Street Botafogo

Tel: (021) 295-8545

Telex: (021) 21280 CNEN BR 22294 - Rio de Janeiro, RJ

## Joint Reactor Construction With PRC

*36990047a Rio De Janeiro O GLOBO in Portuguese 15 Jan 88 p 6*

[Text] Brasilia—Brazil and China may now carry out a joint project to construct nuclear reactors, using components provided by the industries of both countries. Upon its promulgation by President Sarney, the Accord on Peaceful Cooperation in the Nuclear Energy Field between the People's Republic of China [PRC] and Brazil went into effect yesterday. The accord fosters exchanges in technical fields and personnel training, and was signed in November by the two countries' foreign ministers.

The promulgation decree, containing slightly over 10 lines, notes that the majority of the reactors will be experimental in nature. China, like Brazil, is greatly interested in the construction of reactors fed with thorium, a low radioactivity fuel procured from monazite sands. Unlike uranium, thorium is not considered a rich fuel, and its price on the international market is extremely low. Preliminary studies made at the Aerospace Technical Center indicate that it is an excellent alternative from the standpoint of energy production, costing 50 percent less than uranium, and producing 70 percent of the energy procured with uranium in traditional reactors.

At present, thorium is being investigated only in China, India, and Brazil. The accord gives priority to research on the construction of a reactor that would use this type of fuel; basically, a fast breeder, fed by thorium and stimulated by a small amount of enriched uranium. This fact is extremely important to these countries, which, together, hold nearly all of the world's thorium reserves.

Another important point in the accord is the allocation of technology already developed in China to construct heavy water-cooled reactors fed by non-enriched uranium. The Army's Technolgical Center is working on this, backed by the University of Rio de Janeiro Nuclear Studies Center.

According to Itamaraty, the accord will not damage the country's image in its diplomatic relations with the Western nations, inasmuch as it is completely peaceful in nature. Brazil did not sign the International Treaty on Non-Proliferation of Nuclear Weapons of 1968, considering it discriminatory toward developing nations. Nevertheless, it did sign the treaty to ban nuclear weapons in Latin America (the Treaty of Tlatelolco), making its position on the issue clear.

Physicist Luiz Pinguelli Rosa, a member of the Ministry of Science and Technology's National Council for Scientific and Technical Development. regarded the nuclear accord between Brazil and the People's Republic of China as quite positive, but did not conceal his concern that there might be cooperation between the two countries for military purposes.

Pinguelli remarked: "A scientific agremeent with other countries, particularly those of the socialist bloc, which have been virtually ignored by the military regime governments, is always positive. But if this accord includes items concerning the exchange of technology for military purposes, I am radically opposed."

He claims that there is a great deal of confusion in these agreements regarding nuclear energy appliations. Pinguelli gave a reminder that the Institute of Energy and Nuclear Research, controlled by the Navy, has been developing reactor plans for the purpose of building an atomic submarine.

"To make that project viable, Brazil needs enriched uranium, and it has not mastered that technology. We know that the United States, the Soviet Union, and other European countries do not supply that technology for military applications. Would China possibly cooperate in that area?" asks the physicist.

Although stressing his concern, Pinguelli hopes that Brazil and China may carry out joint projects, and "establish a positive exchange of technology for peaceful purposes."

Luis Pinguelli, who is also director of COPPE (Coordinator of Post-Graduate Programs in Engineering), has special affection for China.

The Brazilian scientist, who makes a point of stressing the political aspect of the accord, remarks: "In 1984, I visited the Institute of Nuclear Physics in Beijing and was able to learn about very interesting projects at close range. The following year, we received a visit from Chinese scientists. For all these reasons, I view this accord with great sympathy, provided, I repeat, that it does not include exchanges of technology for military applications. A mutual cooperation pact with China ends the prejudice against the socialist countries."

Physicist Rogerio Cesar de Cerqueira Leite, from Campinas State University, comments: "Brazil has much to gain from an agreement with China in the nuclear field." According to the scientist, China is greatly advanced in all the key technology, specifically, in the nuclear field. It is now making its own reactors, and it has for some time been producing atomic bombs with both fission and fusion. But he emphasizes that this feasibility relates exclusively to a nuclear accord with peaceful applications, "because military applications would be impossible to include in the accord."

Marcelo Dami, professor of nuclear physics at Sao Paulo's PUC [Pontifical Catholic University], comments: "The agreement on cooperation is useful, because if affords opportunities for exchange of information between the scientists of the two countries." In the physicist's opinion, cooperation in the nuclear field "is a declaration of understanding, and also good will and

interest on both sides." According to Marcelo Dami, the benefits that an accord of this type could bring will always depend on good relations between Brazilian and Chinese nuclear scientists:

"It is a well-known fact that China has a highly developed nuclear program, particularly insofar as peaceful applications of the atom are concerned. Hence, this cooperation could prove useful to the country."

2909

## SCIENCE & TECHNOLOGY POLICY

### Brazil To Remove Roadblocks to Technological Imports

*36990043a Rio de Janeiro O GLOBO in Portuguese 7 Jan 88 p 26*

[Text] Brasilia—The Government's industrial policy initiative, which has already been finalized in a draft decree-law by the working group of the Ministry of the Treasury and the Ministry of Industry and Commerce, and which must be sent forward to the President of the Republic after final review by the new Minister of the Treasury, will facilitate the procurement of foreign technology considered indispensable to the country's industrial development by the companies operating in Brazil. The new industrial policy will remove the barriers in the current tax code which tend to block this type of import.

The decree-law on industrial policy also clarifies that the tax and financial benefits are restricted to the companies whose industrial activities come within the scope of sectoral programs or execute designs or plans for industrial technology development, and the firms that participate in the Special Export Program (BEFIEX), which is aimed at modernization and increased competitiveness of the country's industrial base in order to serve the domestic market and increase exports.

Likewise, the policy's most significant innovation is that the tax and financial benefits, previously granted through isolated projects, will be granted only to those firms that participate in the sectoral programs to be defined by the Industrial Development Council (CDI), the Ministry of Industry and Commerce, except for the defense industry and high technology firms.

The new industrial policy also eliminates the need for any prior official authorization for implementation of industrial projects, either foreign or domestic, that do not benefit from fiscal, financial, exchange, and tariff subsidies or incentives.

The decree still maintains incentives aimed at reducing the income tax on companies participating in the BEFIEX: deduction of losses occurring in a fiscal year to recoup profits within the following 6 years; a Federal tax credit equal to the amount collected as a supplementary income tax on the remittance of dividends arising from the profit made on the export of products connected with the BEFIEX Program; and, specifically for companies located in the areas of the SUDENE and SUDAM, exemption from the tax on industrialized products involved in the purchase of raw materials.

13331

## TECHNOLOGY TRANSFER

### Brazil, PRC To Manufacture Thorium Nuclear Reactors

*36990044a Madrid EFE in Spanish 1532 GMT 16 Jan 88*

[Text] Brasilia, 16 Jan (EFE)—The IAEA will supervise the work of Brazilian and PRC experts in their joint effort to manufacture nuclear reactors fueled by thorium, which is less radioactive than uranium.

The condition is included in the agreement between the two countries signed by President Jose Sarney in Brasilia on 14 January.

Through the safeguard clause Brazil and the PRC agreed to IAEA supervision of the work on and security of nuclear reactors to be built by the two countries.

The Brazilian-PRC agreement also restricts the export to other countries of materials exchanged between the two countries, to reduce the risk of nuclear proliferation.

The PRC and Brazil have decided to grant priority to the research on nuclear reactors fueled by thorium because Brazil has the largest reserves of thorium in the world.

According to Brazilian authorities, the thorium deposits, which are extracted from monazite sand, are large enough to supply Brazil's electricity needs for the next 10,000 years.

The Brazilian Foreign Ministry today reiterated that the nuclear agreement with the PRC will only be used for the production of energy for peaceful purposes.

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